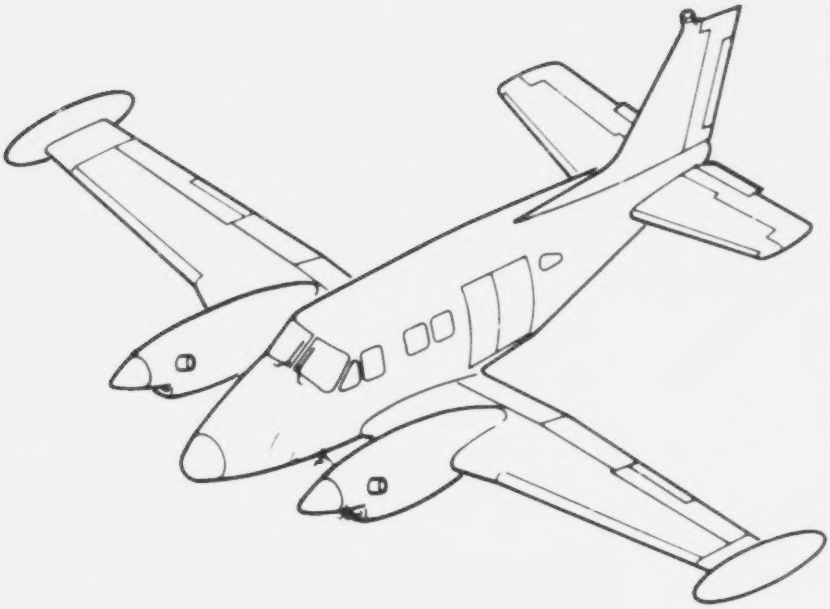
55-1510-209-10-1

TM 55-1510-209-10-1

TECHNICAL MANUAL
OPERATOR'S MANUAL
FOR
ARMY RU-21A AND RU-21D
AIRCRAFT



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- WEIGHT BALANCE AND LOADING
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- EMERGENCY PROCEDURES
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- ALPHABETICAL INDEX

HEADQUARTERS
DEPARTMENT OF THE ARMY
29 OCTOBER 1982

This copy is a reprint which includes current pages from Changes 1.

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CHANGE
NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 26 MARCH 1985

Operator's Manual
for
ARMY RU-21A AND RU-21D AIRCRAFT

TM 55-1510-209-10-1, 29 October 1982, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
8-21 and 8-22	8-21 and 8-22
9-9 and 9-10	9-9 and 9-10

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

DONALD J. DELANDRO
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-31, Operator Maintenance Requirements for U-21A/RU-21A&D Aircraft.

WARNING PAGE

Personnel performing operations, procedures, and practices which are included or implied in this technical manual shall observe the following warnings. Disregard of these warnings and precautionary information can cause injury, or death.

STARTING AIRCRAFT

Operating procedures or practices defined in this Technical Manual must be followed correctly. Failure to do so may result in personal injury or loss of life. Exposure to exhaust gasses shall be avoided since exhaust gasses are an irritant to eyes, skin and respiratory system.

NOISE LEVELS

Sound pressure levels in this aircraft during some operating conditions exceed the Surgeon General's hearing conservation criteria, as defined in TB MED 501. Hearing protection devices, such as the aviator helmet or ear plugs are required to be worn by all personnel in and around the aircraft during its operation.

OPERATION OF AIRCRAFT ON GROUND

At all times during a towing operation, be sure there is a person in the cockpit to operate the brakes.

Engines will be started and operated by authorized personnel (AR 95-1).

HIGH VOLTAGE

High voltage is a possible hazard around mission or INS components.

USE OF FIRE EXTINGUISHERS IN CONFINED AREAS

Monobromotrifluoromethane (CF3Br) is very volatile, but is not easily detected by its odor. Although non-toxic, it shall be considered to be about the same as other freons and carbon dioxide, causing danger to personnel primarily by reduction of oxygen available for proper breathing. During operation of the fire extinguisher, ventilate personnel areas with fresh air. The liquid shall not be allowed to come into contact with the skin, as it may cause frostbite or low temperature burns because of its very low boiling point.

VERTIGO

The rotating beacon light should be turned off during flight through clouds to prevent sensations of vertigo as a result of reflections of the light on the clouds. The external rear view mirror should also be retracted or adjusted so as to prevent any reflected light from entering the cockpit.

CARBON MONOXIDE

When smoke, suspected carbon monoxide fumes, or symptoms of lack of oxygen (hypoxia) exist, all personnel shall immediately don oxygen masks (if available), and activate the oxygen system.

FUEL AND OIL HANDLING

Turbine fuels and lubricating oils contain additives which are poisonous and readily absorbed through the skin. Do not allow them to remain on skin.

SERVICING AIRCRAFT

When conditions permit, the aircraft shall be positioned so that the wind will carry the fuel vapors away from all possible sources of ignition. The fueling unit shall maintain a distance of 20 feet between unit and filler point. A minimum of 10 feet shall be maintained between fueling unit and aircraft.

Prior to refueling, the hose nozzle static ground wire shall be attached to the grounding lugs that are located adjacent to filler openings.

SERVICING BATTERY

Improper service of the nickel-cadmium battery is dangerous and may result in both bodily injury and equipment damage. Wear rubber gloves, apron, and face shield when handling batteries. If potassium hydroxide is spilled on clothing, or other material wash immediately with clean water. If spilled on personnel, immediately start flushing the affected area with clean water. Continue washing until medical assistance arrives. The battery shall be serviced in accordance with TM 11-6140-203-14-2 by qualified personnel only.

JET BLAST

Occasionally, during starting, excess fuel accumulation in the combustion chamber causes flames to be blown from the exhausts. This area shall be clear of personnel and flammable materials.

PROPELLER FAILURE

While operating with the PROP GOV IDLE STOP circuit breaker pulled, the secondary low pitch system is inoperative. Should the primary hydraulic low pitch stop and the primary governor fail, the propeller may reverse.

RADIOACTIVE MATERIAL

Instruments contained in this aircraft may contain radioactive material (TB 55-1500-314-25). These items present no radiation hazard to personnel unless seal has been broken. If seal is suspected to have been broken, notify the Radioactive Protective Officer.

RF BURNS

Do not stand near the antennas when they are transmitting.

TECHNICAL MANUAL

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 29 October 1982

Operator's Manual

ARMY MODELS RU-21A AND RU-21D

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to Commander, US Army Troop Support and Aviation Material Readiness Command, ATTN: DRSTS-MPSD, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished to you.

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***This manual supersedes TM 55-1510-209-10-1, 28 February 1977, including all changes.**

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CHAPTER 1

INTRODUCTION

1-1. General.

These instructions are for use by the operator. They apply to RU-21A and RU-21D aircraft.

1-2. Warnings, Cautions, and Notes.

Warnings, cautions, and notes are used to emphasize important and critical instructions and are used for the following conditions:

WARNING

An operating procedure, practice, etc., which if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

An operating procedure, condition, etc., which is essential to highlight.

1-3. Description.

This manual contains the best operating instructions and procedures for the RU-21A and RU-21D aircraft under most circumstances. The observance of limitations, performance, and weight/balance data provided is mandatory. The observance of procedures is mandatory except when modification is required because of multiple emergencies, adverse weather, terrain, etc. The pilot's flying experience is recognized, and therefore, basic flight principles are not included. **THIS MANUAL SHALL BE CARRIED IN THE AIRCRAFT AT ALL TIMES.**

1-4. Appendix A, References.

Appendix A is a listing of official publications cited within the manual applicable to and available for flight crews.

1-5. Appendix B, Abbreviations and Terms.

Appendix B is a listing of abbreviations and terms used throughout the manual.

1-6. Index.

The index lists in alphabetical order, every titled paragraph, figure, and table contained in this manual. Chapter 7, Performance Data has an additional index within the chapter.

1-7. Army Aviation Safety Program.

Reports necessary to comply with the safety program are prescribed in AR 385-40.

1-8. Destruction of Army Materiel to Prevent Enemy Use.

For information concerning destruction of Army materiel to prevent enemy use, refer to TM 750-244-1-5.

1-9. Phased Maintenance Checklist.

Phased Maintenance Checklist for the RU-21A and RU-21D are prescribed in TM 55-1510-200-PM.

1-10. Forms and Records.

Army aviators flight record and aircraft maintenance records which are to be used by crew members are prescribed in TM 38-750 and TM 55-405-9.

1-11. Explanation of Change Symbols.

Changes to the text and tables, including new material on added pages shall be indicated by a vertical bar in the outer margin extending close to the entire area of the material affected. Pages with emergency markings, which consist of black diagonal lines around three edges, shall have the vertical bar or change symbol placed along the outer margins between the text and the diagonal lines. Change symbols show current changes only. A minature pointing hand symbol is used to denote a change to an illustration. However, a vertical line in the outer margin, rather than minature pointing hands, is utilized when there have been extensive changes made to an illustration. Change symbols are not used to indicate changes in the following:

a. Introductory material.

b. Indexes and tabular data where the change cannot be identified.

c. Blank space resulting from the deletion of text, an illustration, or a table.

d. Correction of minor inaccuracies, such as spelling, punctuation, relocation of material, etc., unless such correction changes the meaning of instructive information and procedures.

1-12. Series and Effectivity Codes.

Designator symbols such as RU-21A and RU-21D are used in conjunction with text contents, text headings and illustration titles to show limited effectivity of the material. One or more symbol may follow a text heading of illustration title to indicate proper effectivity, unless the material applies to both series and configurations within the manual. If the material applies to both, no designator symbol is used. Where practicable, descriptive information is condensed and combined for both series to avoid duplication.

1-13. Aircraft Designation System.

The designation system prescribed by AR 700-26 is used in aircraft designations as follows:

EXAMPLE RU-21A

R - Modified mission symbol (reconnaissance)

U - Basic mission and type symbol (utility)

21 - Design number

A - Series symbol

1-14. Use of Words Shall, Will, Should and May.

Within this technical manual the word "shall" is used to indicate a mandatory requirement. The word "should" is used to indicate a nonmandatory but preferred method of accomplishment. The word "may" is used to indicate an acceptable method of accomplishment. The word "will" is used to express a declaration of purpose and may also be used where simple futurity is required.

CHAPTER 2

AIRCRAFT AND SYSTEMS DESCRIPTION AND OPERATION

Section I. AIRCRAFT

2-1. Introduction.

The purpose of this chapter is to describe the aircraft and its systems and controls which contribute to the physical act of operating the aircraft. It does not contain descriptions of avionics and mission equipment, covered elsewhere in this manual. This chapter contains descriptive information and does not describe procedures for operation of the aircraft. These procedures are contained within appropriate chapters in the manual. This chapter also contains the emergency equipment installed. This chapter is not designed to provide instructions on the complete mechanical and electrical workings of the various systems; therefore, each is described only in enough detail to make comprehension of that system sufficiently complete to allow for its safe and efficient operation.

2-2. General.

The RU-21A and RU-21D are unpressurized, low wing, all metal aircraft, powered by two T74-CP-700 turboprop engines. Both models have all-weather capabilities, but the RU-21D is restricted from flight into known icing conditions due to antenna configurations. Distinguishable external features of these aircraft, (fig. 2-1, 2-2), are the slender, streamlined engine nacelles, square-tipped wing and tail surfaces, a swept-back vertical stabilizer and a ventral fin below the empennage. On RU-21D aircraft, vertically oriented antennas are installed on top of the fuselage and also on top of and under the wings. On RU-21A aircraft, wing tip pod antennas are installed. Cabin entrance is made through a stair-type door on the left side of the fuselage. Shock mounted racks for special equipment and chairs for two mission operators are installed within the cabin (fig. 2-3, 2-4). A rack for five M-16 rifles is provided in the aft end of the cabin. Other accommodations include: blackout covering for all windows and a flashing crew call light for each operator controlled by switches accessible to the pilot and copilot. Accommodations include: Two adjustable dimmer controlled lights, one portable fire extinguisher located in the cabin, and one under the copilot's seat, and thermos provisions for one gallon of water. Pilot and copilot seats are side-by-side in the cockpit. The crew required for mission operation consists of the pilot, copilot, and two mission operators. See Table 2-1 for the main differences between models.

2-3. Dimensions.

Overall aircraft dimensions are as follows: (fig. 2-5, 2-6).

Wing Span **RU-21A**	50 ft. 10.50 in.
Wing Span **RU-21D**	45 ft. 10.50 in.
Length	35 ft. 6 in.
Height (at rest)	14 ft. 2.56 in.
Tread (between center lines of main wheels)	12 ft. 9 in.

2-4. Ground Turning Radius.

a. For RU-21A aircraft, the minimum ground turning radius is 31 feet, 9.75 inches (fig. 2-7).

b. For RU-21D aircraft, the minimum ground turning radius is 29 feet, 8.75 inches (fig. 2-8).

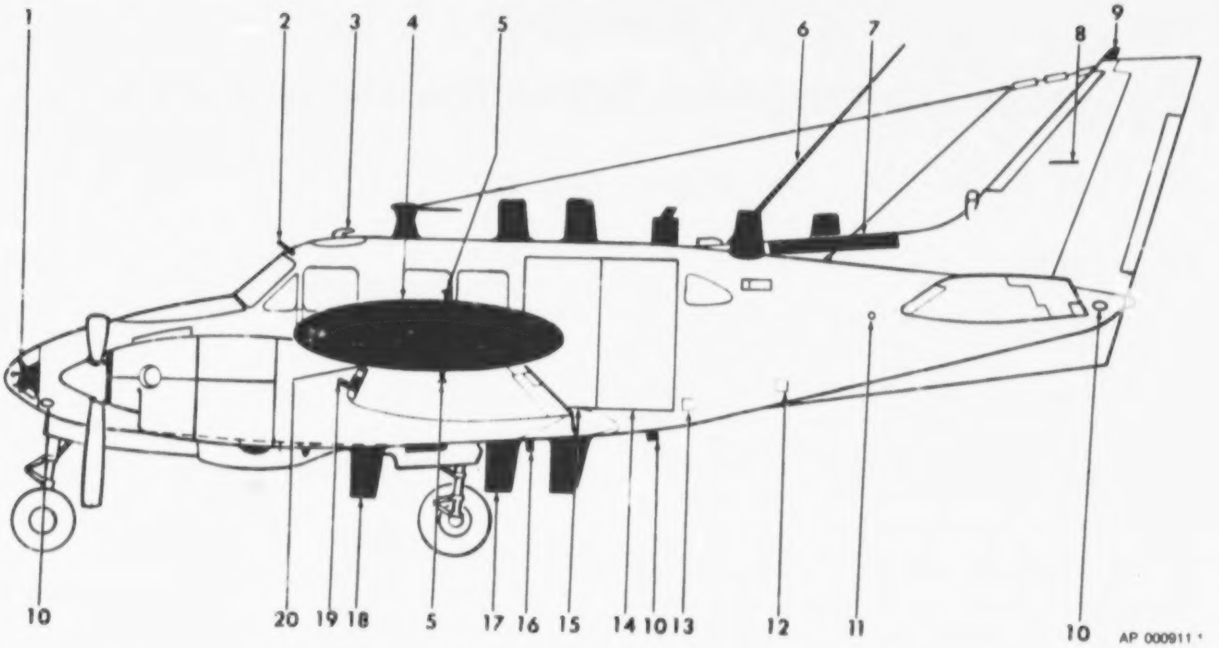
2-5. Maximum Weights.

a. For RU-21A aircraft, maximum takeoff gross weight is 10,200 pounds. Maximum landing weight is 9700 pounds, maximum ramp weight is 10,255 pounds.

b. For RU-21D aircraft, maximum takeoff gross weight is 9650 pounds. Maximum landing weight is 9168 pounds. Maximum ramp weight is 9705 pounds.

2-6. Landing Gear System.

The landing gear is a retractable, tricycle type, electrically operated by a single DC motor. This motor drives the main landing gear actuators



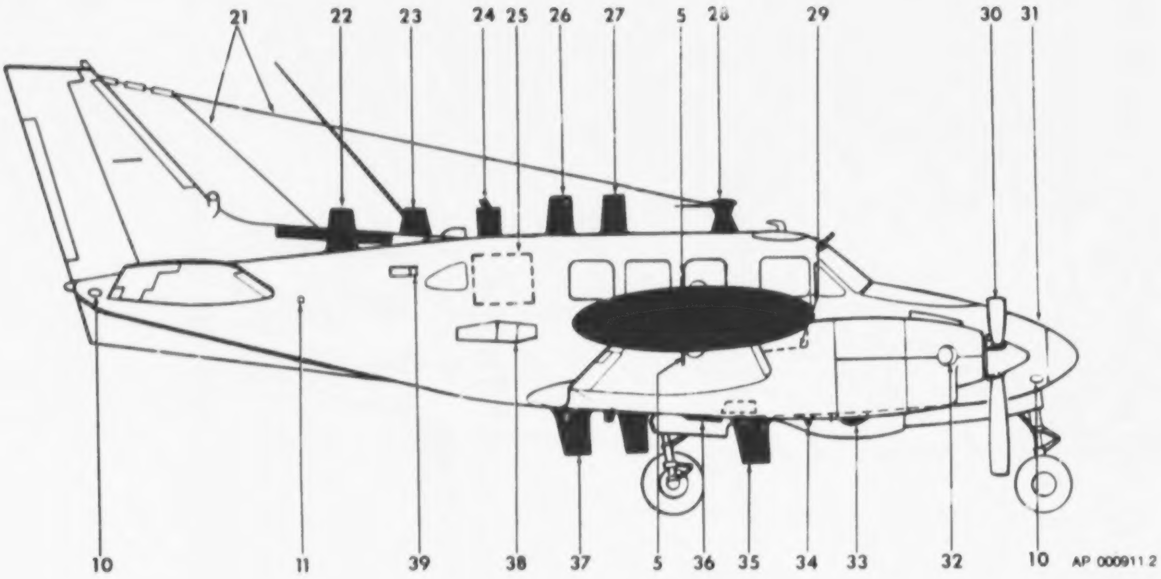
1. Radar antenna
2. Outside air Temperature sensor
3. Cockpit emergency entrance/exit hatch
4. Wing pod mission antenna (2)
5. Radar warning receiver antenna
6. FM antenna
7. ADF sense antenna
8. VOR antenna
9. Data link antenna
10. Radar signal detecting set antenna
11. Static air source
12. INS cooling air exhaust
13. INS cooling air intake
14. Main entrance door
15. Cargo door
16. Transponder antenna
17. Mission blade antenna
18. Mission blade antenna
19. Pitot tube
20. Stall warning vane

Figure 2-1. General Exterior Arrangement **RU-21A** *(Sheet 1 of 2)*

through a gear box and torque tube arrangement, and also drives a chain mechanism which controls the position of the nose gear. Spring-loaded locks secure the main gear in the down position, while the jackscrew in the actuator secures the nose gear in the down position. The jackscrew in each actuator holds all three gears in the up position, when the gears are retracted. A friction clutch between the gearbox and the torque shafts protects the motor from electrical overload in the event of a mechanical malfunction. A 50-ampere push-to-reset type circuit breaker, placarded LANDING GEAR POWER, located on the copilot's circuit breaker and fuse panel (fig. 2-9, 2-10, 2-29, and 2-31), protects against electrical overload. Gear doors are opened and closed through a mechanical linkage connected to the landing gear. The nose wheel steering mechanism is automatically centered and the rudder pedals relieved of the steering load when the landing gear is retracted. Air-oil type shock struts, filled with compressed air and hydraulic fluid, are incorporated with the landing gear. Gear extension or retraction time should take no longer than 8 seconds.

a. Landing Gear Control Switch. Landing gear system operation is controlled by a manually actuated wheel-shaped switch placarded LDG GEAR CONT, UP and DN, on the right subpanel (fig. 2-13, 2-14). The control switch and associated relay circuits are protected by a 5-ampere circuit breaker, placarded LDG GR CONTROL, on the right subpanel (fig. 2-13, 2-14).

b. Landing Gear Down Position-Indicator Lights. Landing gear down position is indicated by



21. HF - AM antenna
22. Mission blade antenna
23. Mission blade antenna
24. TACAN antenna
25. Emergency entrance cutout location
26. VHF - UHF antenna
27. Mission blade antenna
28. VOR/glideslope antenna
29. Chaff dispenser
30. Propeller (2)
31. Nose avionics compartment
32. Engine exhaust stub (4)
33. Marker beacon antenna
34. FM homing antenna
35. UHF - DF loop antenna
36. ADF fixed-loop antenna
37. Mission blade antenna
38. Flare dispenser
39. Cabin air vent outlet

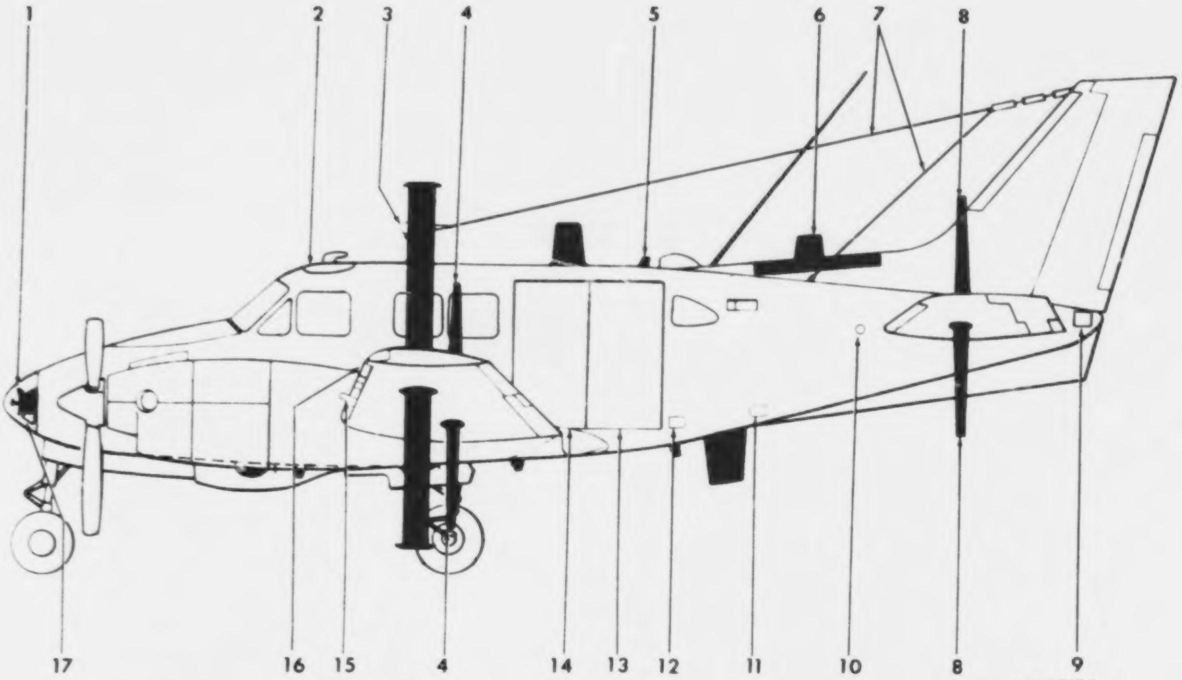
Figure 2-1. General Exterior Arrangement **RU-21A** *(Sheet 2 of 2)*

three green lights on the control pedestal, placarded GEAR DOWN (fig. 2-11, 2-12). These lights have a press-to-test feature. The circuit is protected by a 5-ampere circuit breaker, placarded LG IND, on the right subpanel.

c. Landing Gear Position Warning Lights. Two red bulbs, wired in parallel, are positioned inside the clear plastic grip on the landing gear control handle (fig. 2-13, 2-14). These lights illuminate whenever the landing gear handle is in either the UP or DN position and the gear is in transit. Both bulbs will also illuminate should either or both power levers be retarded below approximately 50% of lever travel when the landing gear is not down and locked. To turn the handle lights OFF, during single-engine operation, the power lever for the inoperative engine must be advanced to a position which is higher than the setting of the warning horn microswitch. Extending the landing gear will also turn the lights off. Both red lights indicate the same warning conditions, but two are provided for a fail-safe indication in the event one bulb burns out. The circuit is protected by a 5-ampere circuit breaker, placarded LDG GR CONTROL, on the right subpanel (fig. 2-13, 2-14).

d. Landing Gear Warning Light Test Button. A test button, placarded HDL LT TEST, is located on the right subpanel (fig. 2-13, 2-14). Failure of the landing gear handle to illuminate red, when this test button is pressed, indicates two defective bulbs or a circuit fault. The circuit is protected by a 5-ampere circuit breaker, placarded LDG GR CONTROL, on the right subpanel (fig. 2-13, 2-14).

e. Landing Gear Warning Horn. When either power lever is retarded below approximately 80%



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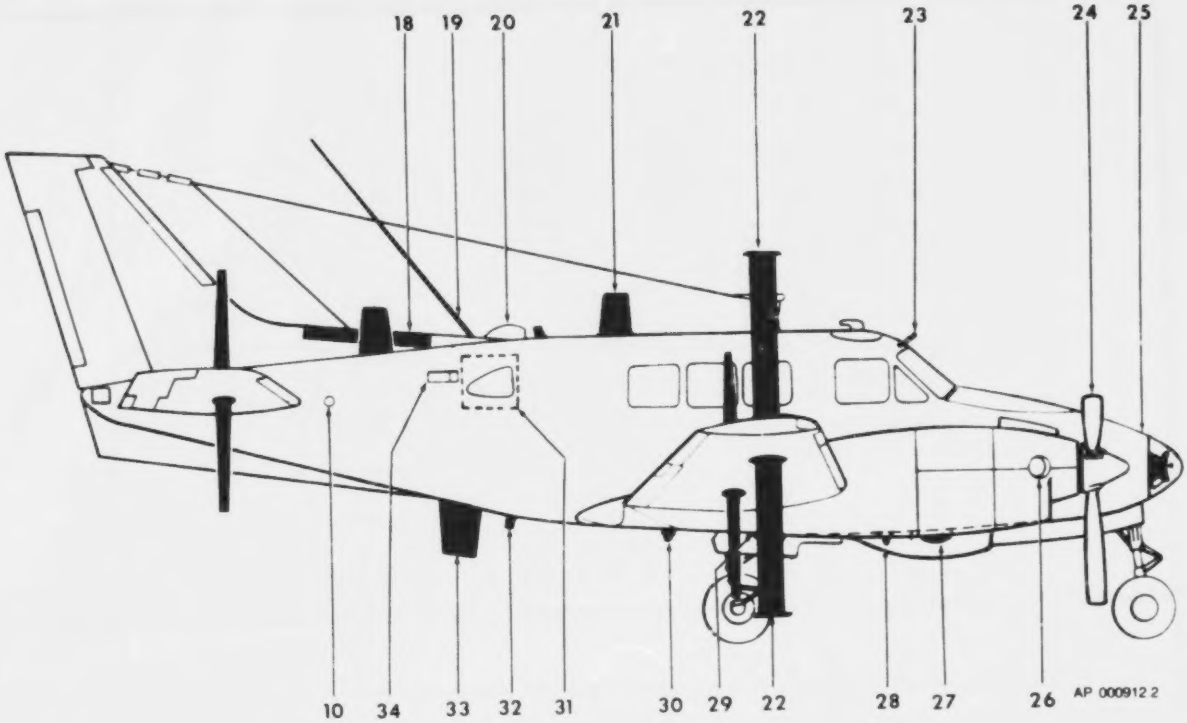
1. Radar antenna
2. Cockpit emergency entrance/exit hatch
3. VOR/glideslope antenna
4. VHF-DF low band mission antenna (2)
5. TACAN antenna
6. FM antenna
7. HF-AM antenna
8. VHF-DF high band mission antenna (2)
9. AFT RHAW vector antenna (2)
10. Static air source
11. INS cooling air exhaust
12. INS cooling air intake
13. Main entrance door
14. Cargo door
15. Pitot tube
16. Stall warn vane
17. Forward RHAW vector antenna (2)

Figure 2-2. General Exterior arrangement **RU-21D** *(Sheet 1 of 2)*

N_1 when the landing gear is not down and locked, a warning horn behind the left side of the instrument panel will sound intermittently. The warning horn circuit is protected by a 5-ampere circuit breaker, placarded LG WARN HORN, on the right subpanel (fig. 2-13, 2-14).

f. Landing Gear Warning Horn Silence Button. The landing gear warning horn can be silenced during flight (with power retarded, gear and flaps up), by pressing the button, placarded WARN HORN SILENCE, on the right subpanel (fig. 2-13, 2-14). After silencing the warning horn, it will remain silent until either the flaps are extended or the power levers are advanced, then retarded again. During single-engine operation, the warning horn may be silenced by either pressing the warning horn silencing button (flaps up) or advancing the power lever for the inoperative engine to a position above the warning horn microswitch setting. If the warning horn has been silenced by pressing the silence button, the power lever for the inoperative engine must again be advanced past the warning horn microswitch setting to reset the switch. The horn will sound however if the power lever for the operative engine is retarded. The circuit is protected by a 5-ampere circuit breaker, placarded LG WARN HORN, on the right subpanel (fig. 2-13, 2-14).

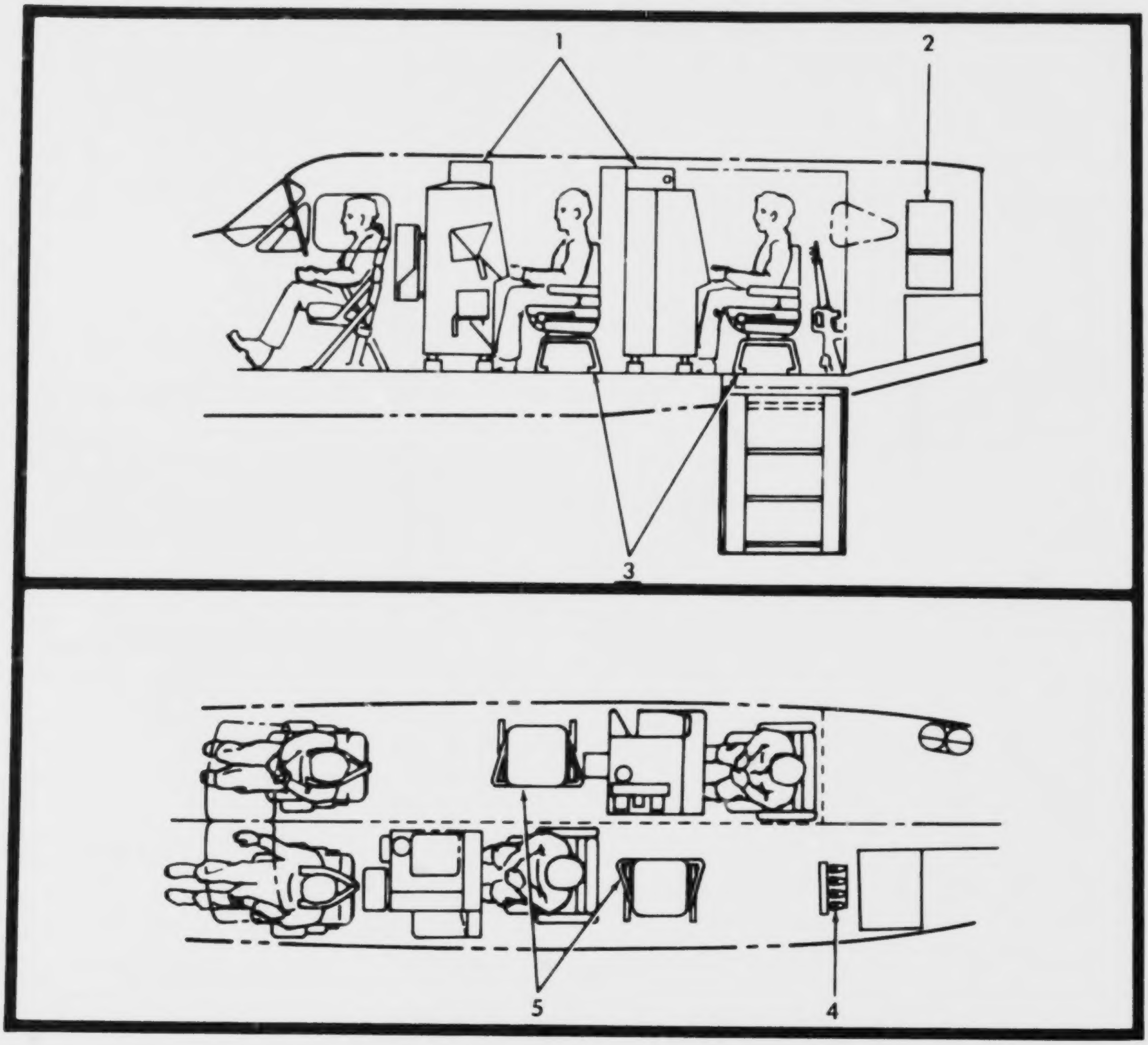
g. Landing Gear Safety Switches. A safety switch on each main landing gear shock strut controls the operation of various aircraft systems that function only during flight or only during



18. ADF sense antenna
19. FM whip antenna
20. Mission console air intake
21. VHF-UHF antenna
22. HF-DF dipole mission antenna (2)
23. Outside air temperature sensor
24. Propeller
25. Nose avionics compartment
26. Engine exhaust stub (4)
27. Marker beacon antenna
28. FM homing antenna
29. ADF fixed-loop antenna
30. Transponder antenna
31. Cabin emergency exit hatch (inaccessible)
32. RHAW omni antenna
33. FM mission antenna
34. Cabin air vent outlet

Figure 2-2 General Exterior Arrangement **RU-21D** *(Sheet 2 of 2)*

aircraft ground operation. These switches are mechanically actuated whenever the main landing gear shock struts are extended (normally after takeoff), or compressed (normally after landing). The safety switch on the right main landing gear deactivates the landing gear control circuits when the strut is compressed - and also deactivates the heating circuits for the lip anti-ice boots for both engines and the heating circuits for the ram air intake boot. This switch also activates a down-lock hook, preventing the landing gear handle from being raised while the aircraft is on the ground. The hook, which unlocks automatically after takeoff, can be manually overridden by pressing down on the red button, placarded DN LCK REL, located adjacent to the landing gear handle (fig. 2-13, 2-14). If the override is used and the landing gear control switch is raised, power will be supplied to the warning horn circuit and the horn will sound. When the left main landing gear strut is compressed the left safety switch establishes circuit continuity so that controls may operate the combustion blower and the ventilation blower (for nose avionics and cockpit/cabin areas). When the left strut is extended, the ventilation blower may not be operated - however, combustion blower circuits are reconnected in flight by the flight operation relay.



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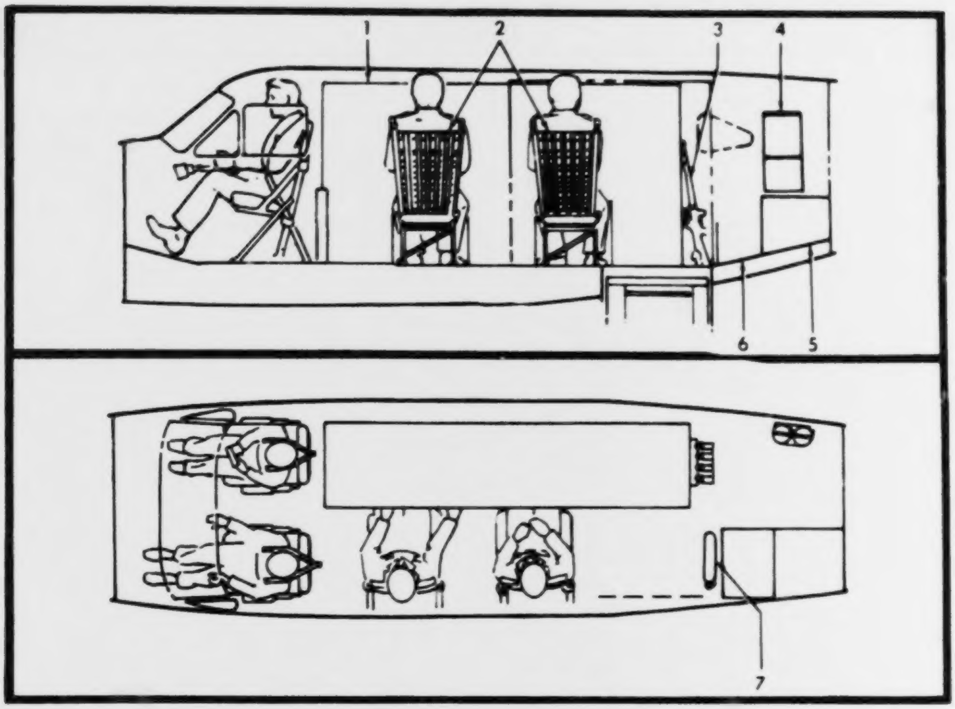
1. Mission consoles
2. Thermos bottle holder
3. Mission operator chairs
4. Rifle rack
5. Typewriter table

Figure 2-3. General Interior Arrangement RU-21A

CAUTION

Do not pump handle after GEAR DOWN position indicator lights (3) are illuminated. Further movement of the handle could damage the drive mechanism.

h. Landing Gear Emergency Clutch Disengage Lever. Prior to emergency or manual gear extension the landing gear motor must be disengaged from the landing gear drive mechanism. This is accomplished by a manually-operated clutch disengage lever (fig. 2-11, 2-12) located adjacent to the landing gear emergency extension handle. To disengage the clutch, pull the



1. Mission console
2. Mission operator chairs
3. Rifle rack
4. Thermos bottle holder
5. INS computer
6. INS platform
7. Fire extinguisher

Figure 2-4. General Interior Arrangement **RU-21D**

clutch lever up and turn clockwise. To engage the clutch, turn the clutch lever counter-clockwise and release.

i. Landing Gear Emergency Extension Handle. The landing emergency extension handle (fig. 2-11, 2-12) located on the cockpit floor to the right of the pilot's seat, is used for manual extension of the landing gear. The landing gear extension system is actuated by pumping the handle up and down. This movement operates a ratchet mechanism which drives the normal system to extend the landing gear. The landing gear cannot be retracted manually. Refer to chapter 9 for emergency gear extension procedures.

2-7. Steerable Nose Wheel.

The aircraft can be maneuvered on the ground by the steerable nose wheel system. Direct linkage from the rudder pedals to the nose wheel steering linkage allows the nose wheel to be turned 12° to the left of center or 14° to the right. When rudder pedal steering is augmented by the main wheel braking action, the nose wheel can be deflected up to 48° either side of center. Shock loads which would normally be transmitted to the rudder pedals are absorbed by a spring mechanism in the steering linkage. Retraction of the landing gear automatically centers the nose wheel and disengages the steering linkage from the rudder pedals.

2-8. Wheel Brake System.

The main landing wheels are equipped with multiple-disc hydraulic brakes actuated by master cylinders attached to the rudder pedals at the pilot's and copilot's position. A shuttle valve, adjacent to each set of pedals, permits braking action changeover from one set of pedals to the other. Brake fluid is supplied to the system from the reservoir in the nose compartment. The toe

Table 2-1. Main Differences

CATEGORY	RU-21A	RU-21D
Console locations (mission equipment)	Located in aft cabin.	Located in aft cabin along right side wall.
Auto-pilot	H-14 (inst.) complete except ref. gyros, which will share with inertial navigation system (INS) to be field installed.	
Communications	Audio C-1611/A1C (two installed)	Audio C-1611/A1C (four installed)
INS inverter	MGH 229-100	PU-543/A
AC external power receptacle	One installed (also have AC external power switch on instr. panel)	
Generators	250-ampere generators	300-ampere generators
Aircraft survivability equipment	XM-130 chaff/flare dispensing system AN/APR-39(V)1 or AN/APR-39(V)2 radar signal detecting set AN/APR-44( )(V)3 radar warning receiver	

brake sections of the rudder pedals are connected to the master cylinders which actuate the system for the corresponding wheels. No emergency brake system is provided. Repeated and excessive application of brakes, without allowing sufficient time for cooling, will cause loss of braking efficiency, possible failure of brake or wheel structure, possible blowout of tires, and in extreme cases may cause the wheel and brake assembly to be destroyed by fire. Parking brakes shall not be set during flight. The following precautions should be observed insofar as is practical:

a. Extreme care should be used during any braking application to prevent skidding the tires and causing flat spots.

b. With the landing gear extended, approximately 10 minutes should be allowed to elapse between landings where maximum braking has been applied.

c. With the landing gear retracted, approximately 30 minutes should be allowed to elapse between maximum-brake application landings.

CAUTION

It is damaging to the braking system if continuous braking drag is applied over an appreciable distance while taxiing at slow speeds.

***d.* For short landing rolls, reversing the propellers and a single, smooth application of the brakes with constantly increasing pedal pressure is most desirable.**

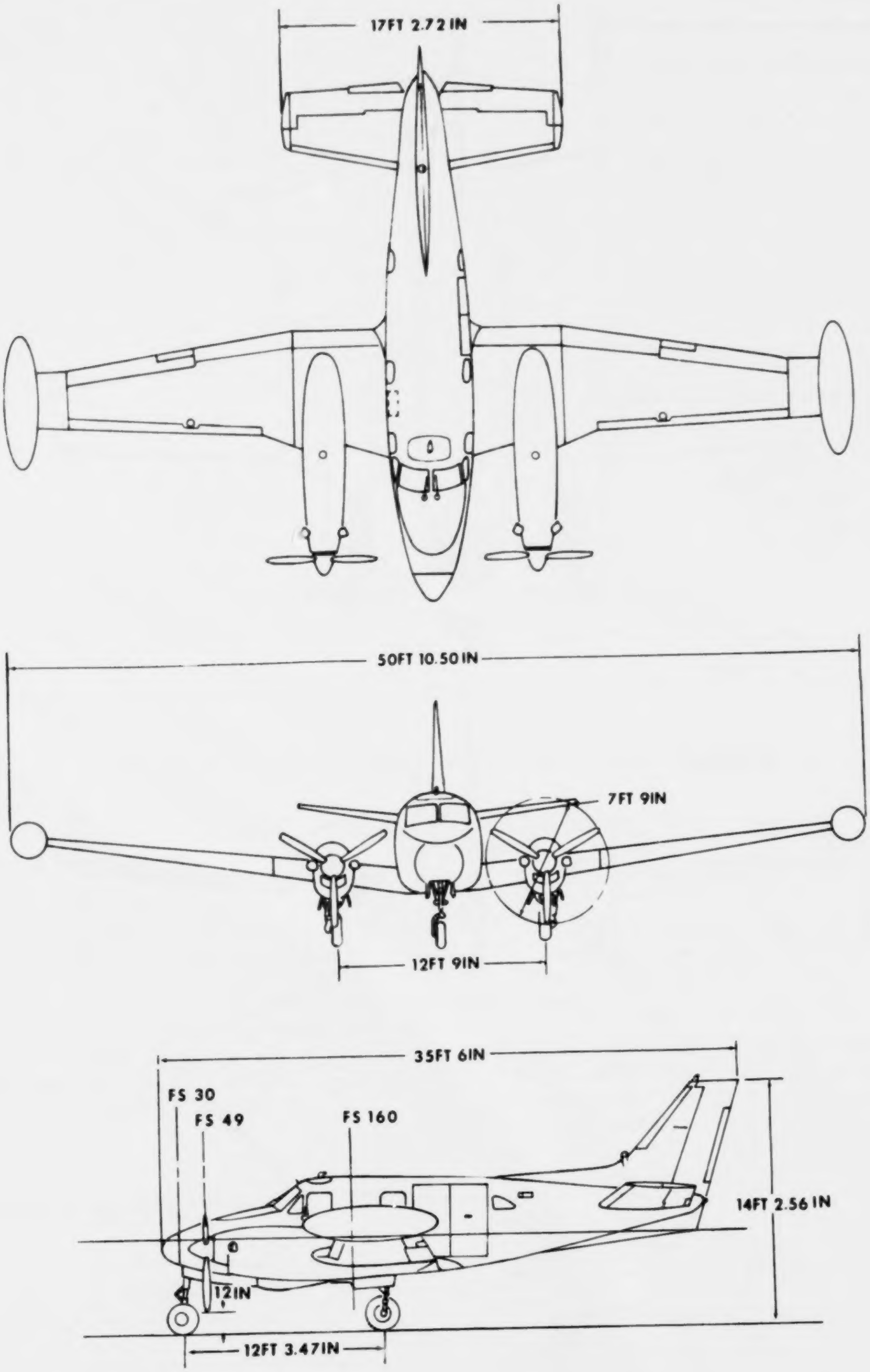


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Figure 2-5. Principal Dimensions **RU-21A**

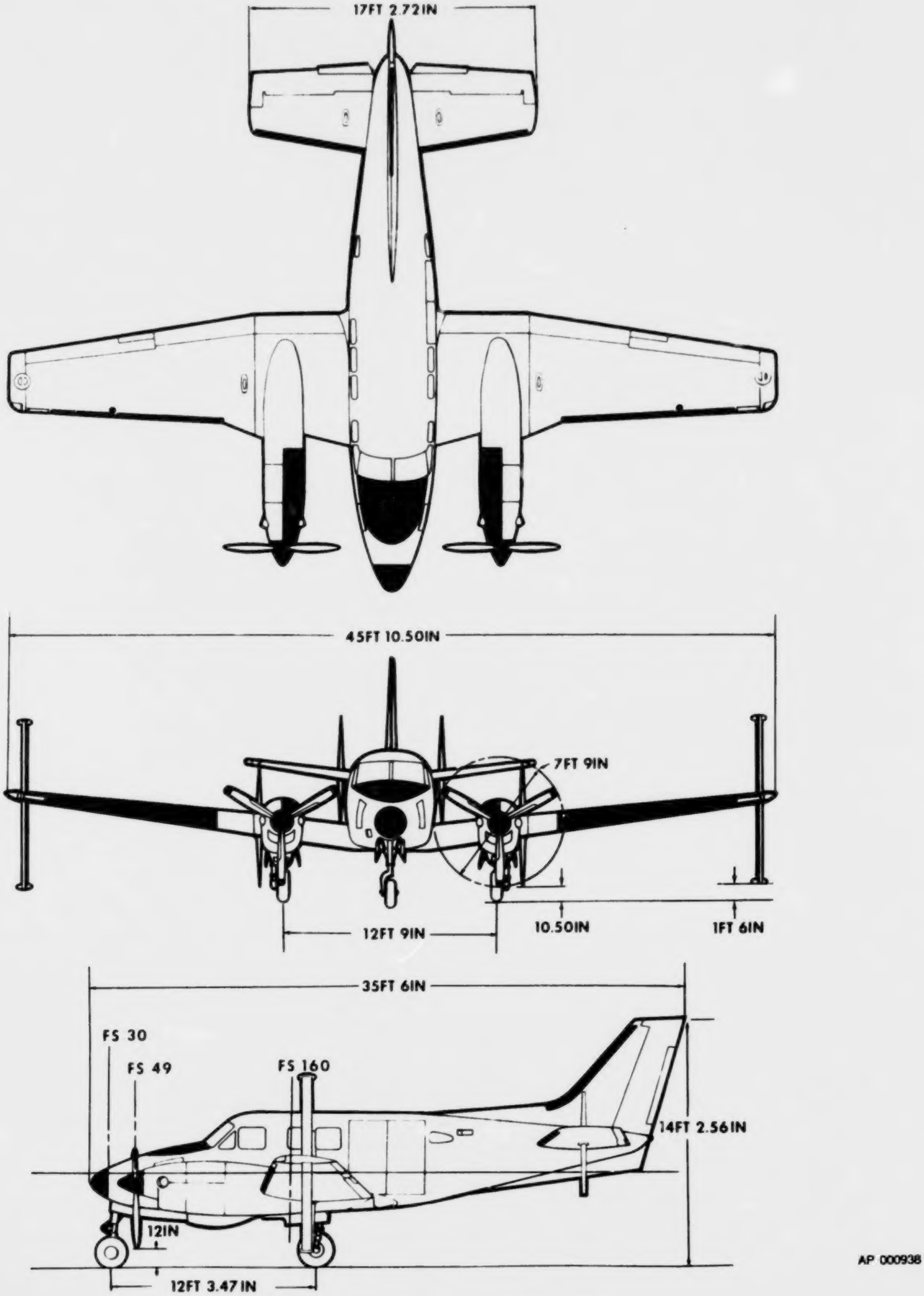
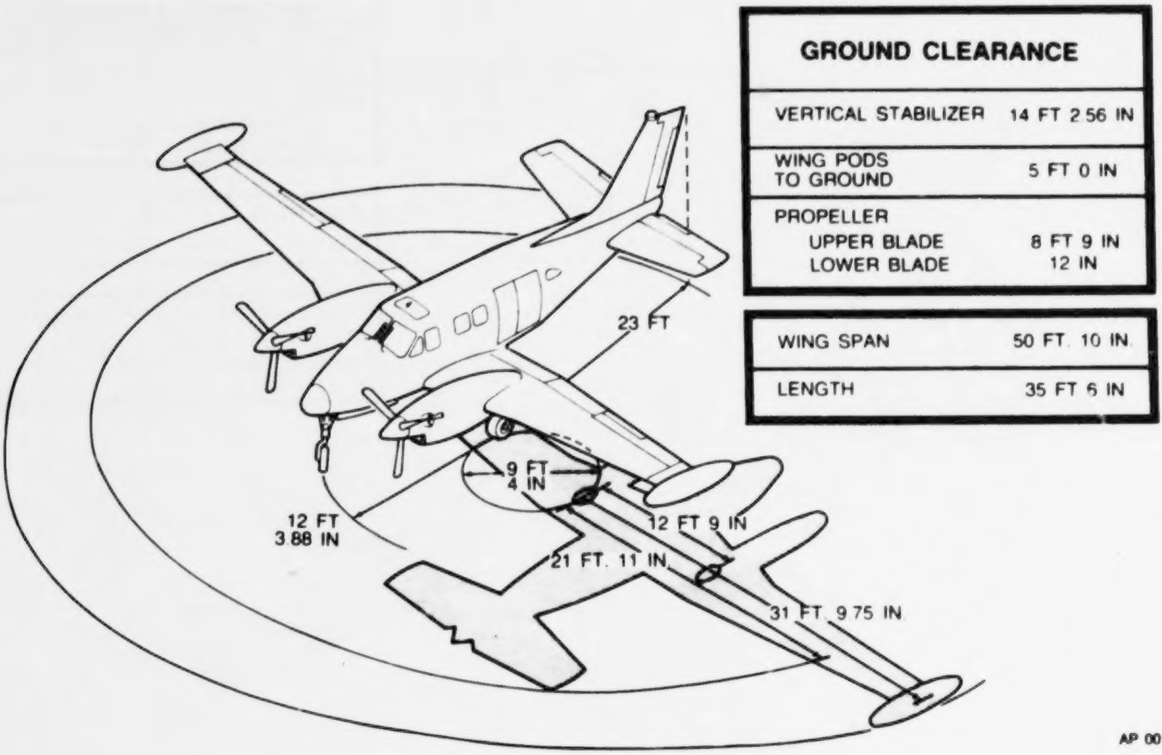


Figure 2-6. Principal Dimensions **RU-21D**



GROUND CLEARANCE	
VERTICAL STABILIZER	14 FT 2.56 IN
WING PODS TO GROUND	5 FT 0 IN
PROPELLER	
UPPER BLADE	8 FT 9 IN
LOWER BLADE	12 IN

WING SPAN	50 FT. 10 IN.
LENGTH	35 FT 6 IN

Figure 2-7. Turning Radius and Ground Clearance **RU-21A**

2-9. Parking Brake Handle.

Dual parking brake valves are installed adjacent to the rudder pedals between the master cylinders of the pilot's rudder pedals and the wheel brakes. Both valves can be closed simultaneously by pulling out the handle placarded PARKING BRAKE on the left subpanel (fig. 2-13, 2-14), then pressing both brake pedals on the pilot's side to build up pressure. Parking brakes are released when the brake handle is pushed in.

2-10. Entrance and Exit Provisions.

WARNING

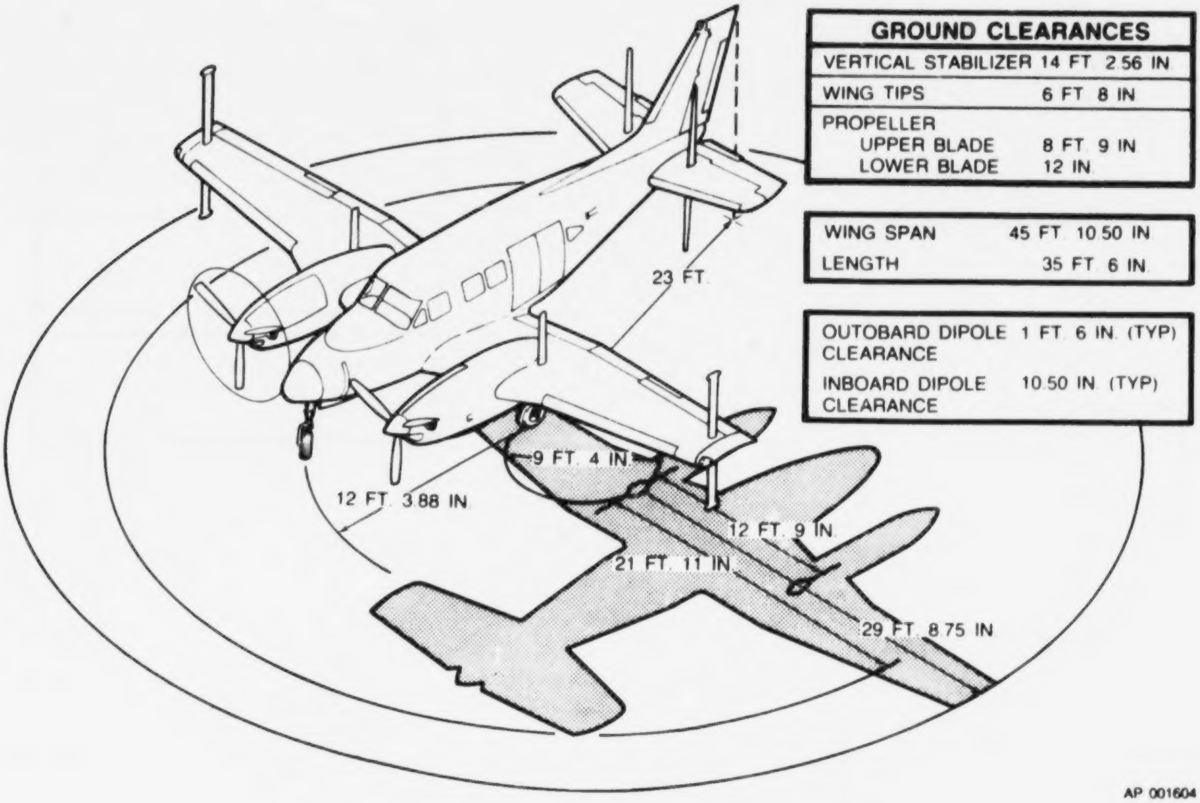
Do not open door or attempt to lock or secure it during flight.

CAUTION

Structural damage may be caused if more than one person is on the entrance door at any time.

The cabin main entrance door is used for normal entry into the aircraft and for normal or emergency exit (fig. 2-15). The main entrance door and the cockpit windshields provide the only emergency escape routes from the aircraft, either on the ground or when ditching. The removable cabin escape window is blocked by a mission console in all RU-21A and RU-21D aircraft. Refer to chapter 9 for emergency exit locations and bailout procedures.

a. Aircraft entrance door provisions consist of two adjoining door assemblies on the left side of the fuselage which open outward from the cabin compartment. The forward, or cargo door is normally closed during egress of the crew. The



GROUND CLEARANCES	
VERTICAL STABILIZER	14 FT. 2.56 IN.
WING TIPS	6 FT. 8 IN.
PROPELLER	
UPPER BLADE	8 FT. 9 IN.
LOWER BLADE	12 IN.

WING SPAN	45 FT. 10.50 IN.
LENGTH	35 FT. 6 IN.

OUTOBARD DIPOLE CLEARANCE	1 FT. 6 IN. (TYP)
INBOARD DIPOLE CLEARANCE	10.50 IN. (TYP)

Figure 2-8. Turning Radius and Ground Clearance **RU-21D**

cargo door is secured in a closed position by two hand-operated, locking slide-bolts, located on the top and bottom aft corners of the door. The door opens forward on two hinges and is held open by a swivel rod, which inserts into a hold-fitting installed in the wing fairing below the door opening. A cable attaches to the door top and to inside fuselage structure above the door opening, preventing damage due to door overswing. The aft side of the cargo door is part of the frame structure for the main entrance door, and has striker plates for securing the door in the closed position. The main entrance door must be open before the cargo door can be opened.

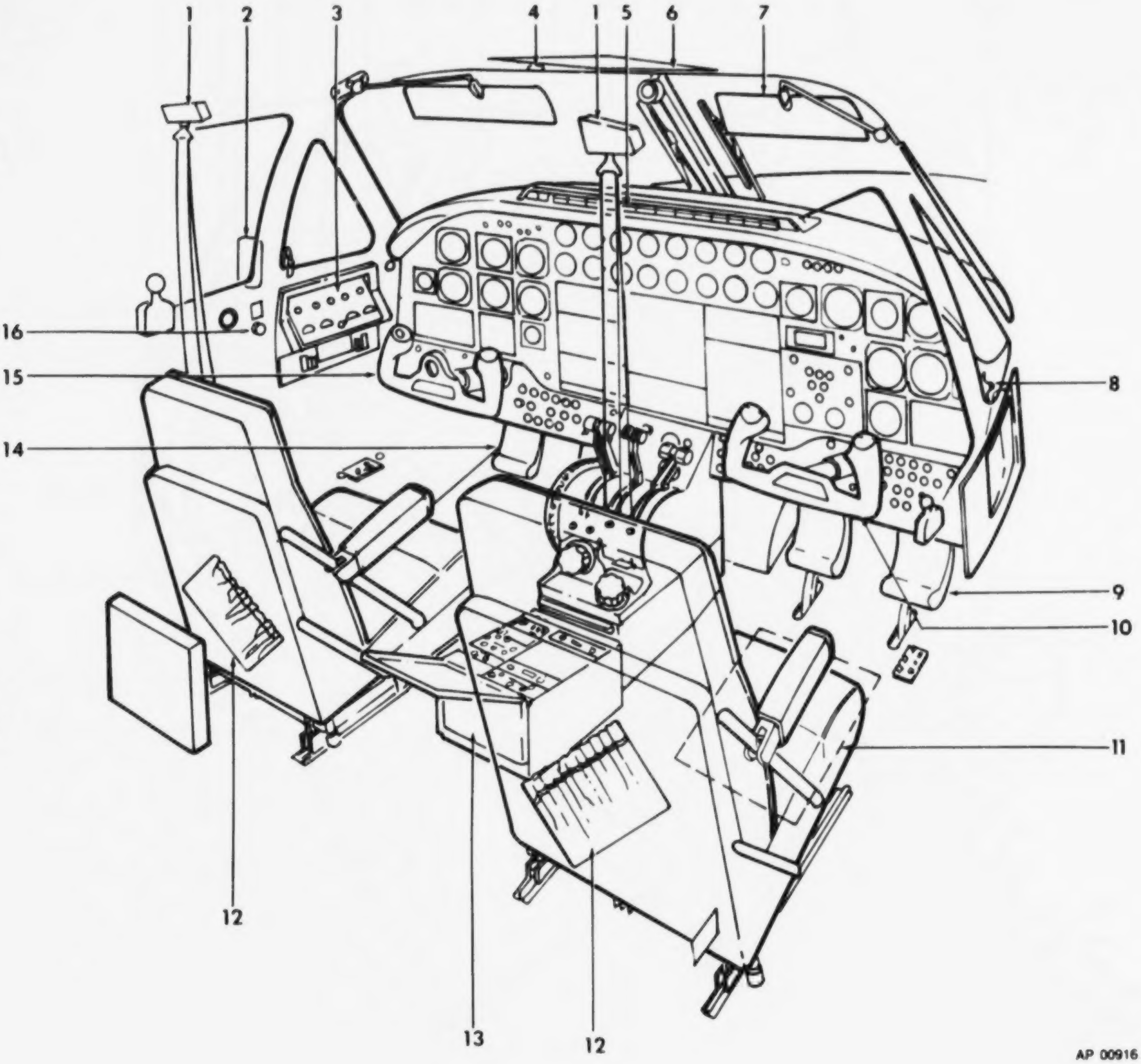
b. Normal aircraft entry and exit is accomplished through the main entrance door. This door may be opened or closed from either the inside or outside of the aircraft by clockwise/counterclockwise rotation of the door handles. The stair-type steps are integrally mounted on the inside of the door. A plastic encased cable provides a stop to support the door in the open position, serves as a hand assist during entry or exit, and as a convenience for closing the door from the inside.

2-11. Cabin Door Warning Light.

WARNING

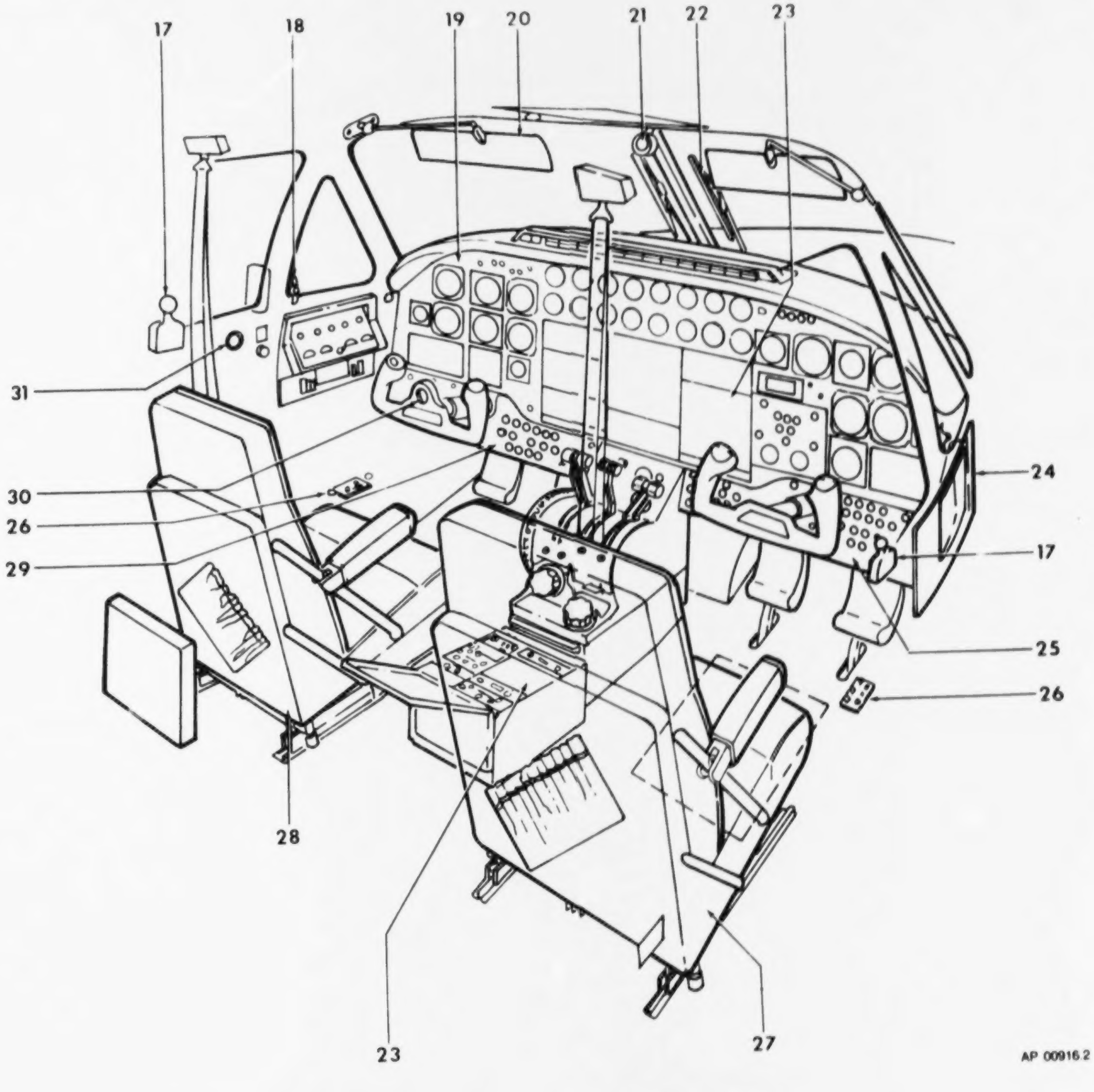
Do not open door or attempt to lock or secure it during flight.

As a safety precaution, one flashing FAULT WARN light (fig. 2-36, 2-37), on the instrument panel and a steady illuminated cabin door open red light on the annunciator panel (fig. 2-36, 2-37) indicate the main entrance door is not closed and locked. This circuit is protected by a 5-ampere circuit breaker, placarded ANN PANEL, located on the right subpanel (fig. 2-13, 2-14).



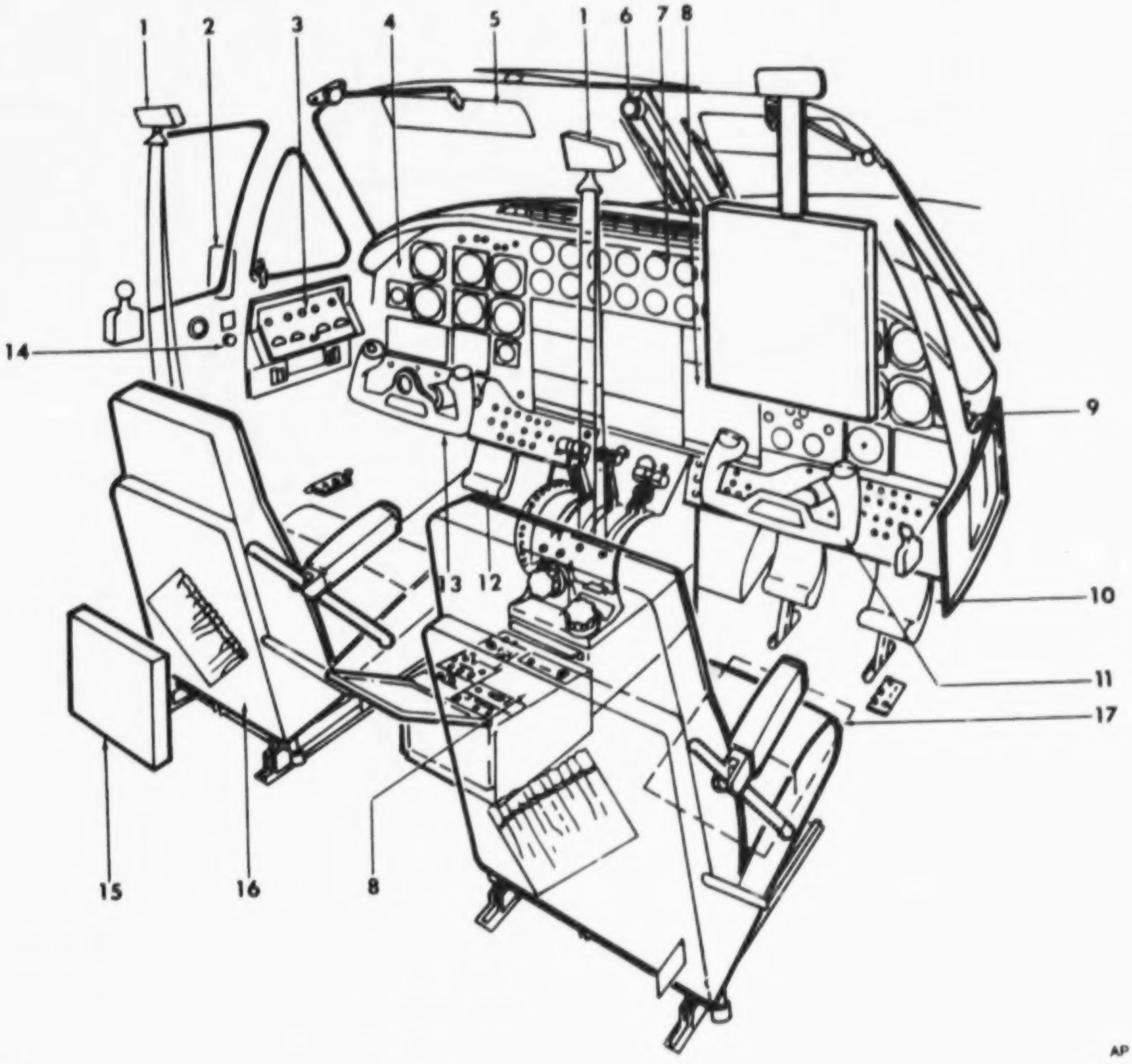
1. Shoulder harness inertia reel
2. External rear view mirror
3. Fuel management panel
4. Free air temperature gage
5. Annunciator panel
6. Overhead control panel
7. Copilot's sunvisor
8. Copilot's storm window lock
9. Copilot's rudder pedals
10. Copilot's control wheel
11. Drift sight window
13. Control pedestal extension
14. Pilot's rudder pedals
15. Pilot's control wheel
16. External mirror actuation knob

Figure 2-9. Cockpit RU-21A *(Sheet 1 of 2)*



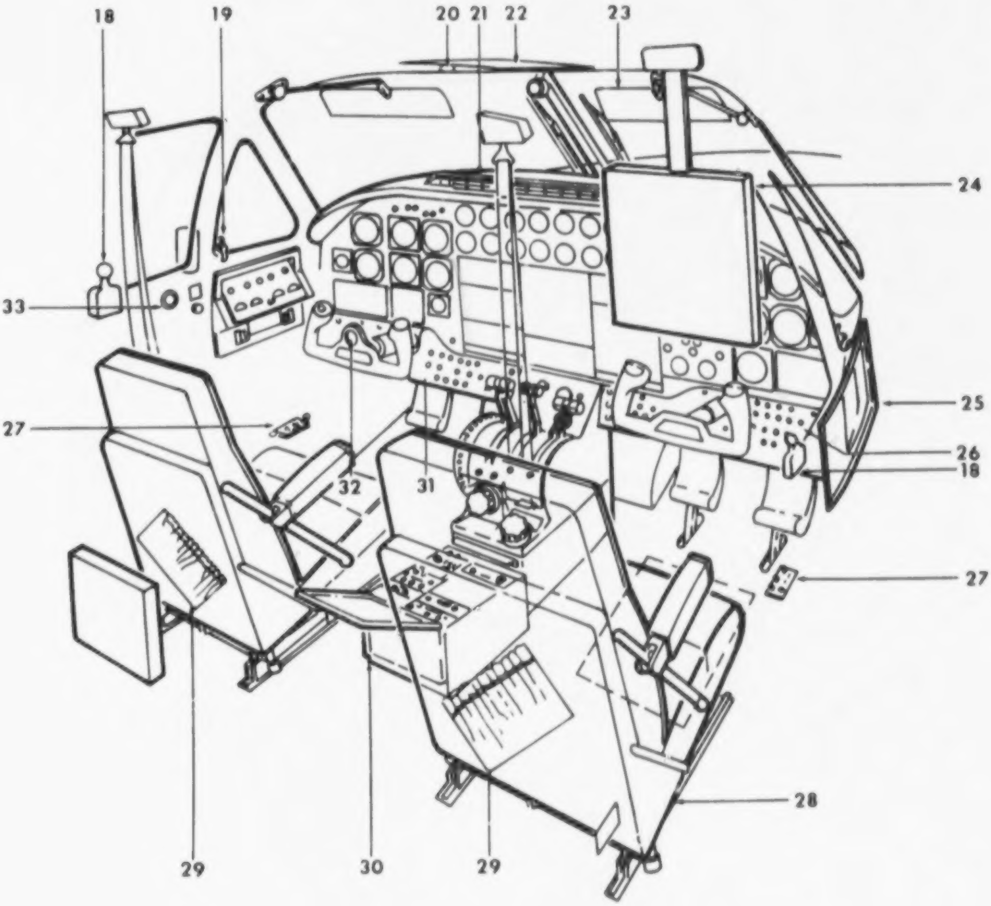
17. Shoulder harness lock lever
18. Pilot's storm window lock
19. Instrument panel
20. Pilot's sunvisor
21. Magnetic compass
22. Windshield wipers
23. Avionics control panel
24. Copilot's circuit breaker and fuse panel
25. Right subpanel
26. Oxygen regulator control panel
27. Pilot's seat
28. Copilot's seat
29. Left subpanel
30. 8-day clock
31. System oxygen gage

Figure 2-9. Cockpit **RU-21A** *(Sheet 2 of 2)*



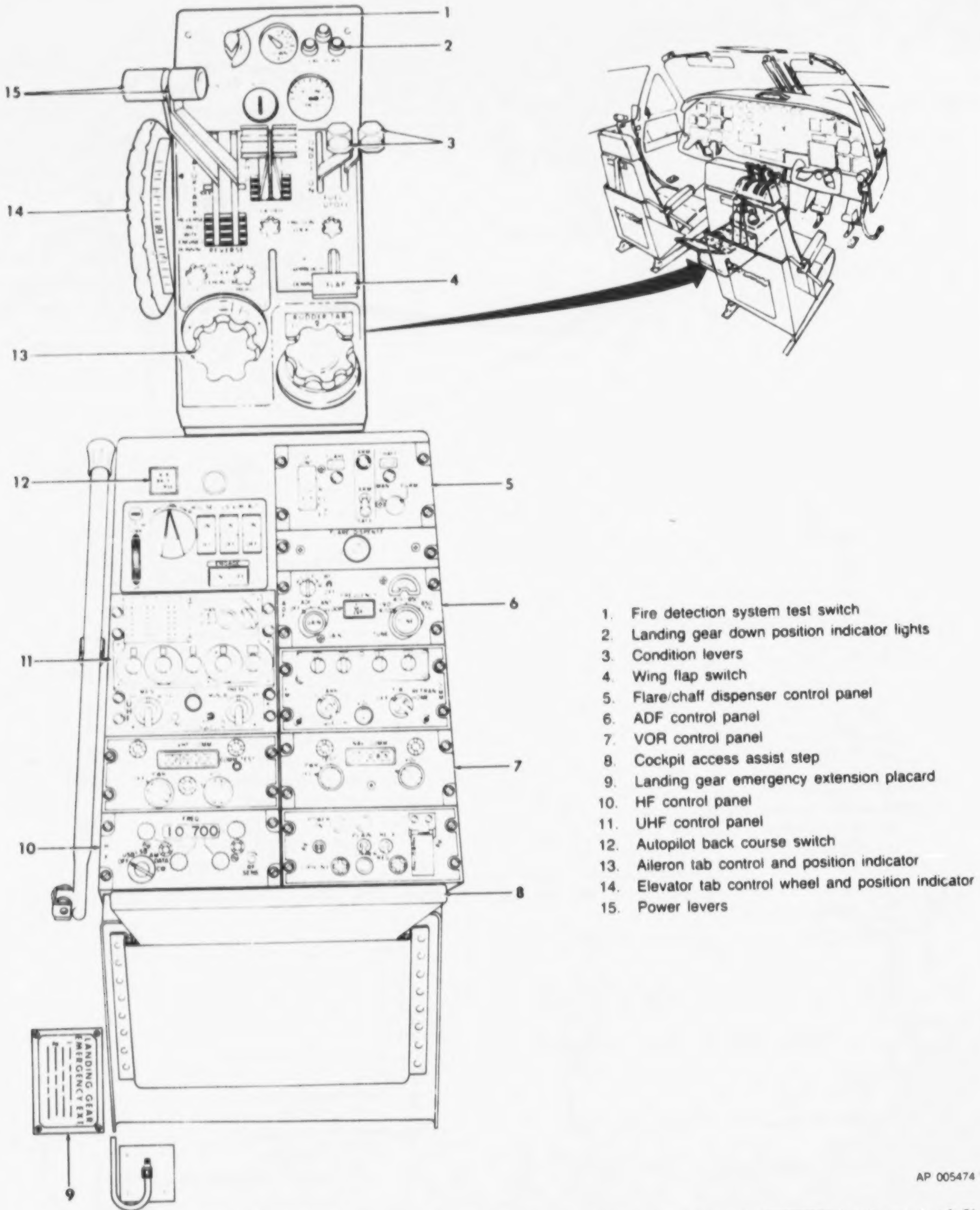
1. Shoulder harness inertia reel
2. External rear view mirror
3. Fuel management panel
4. Instrument panel
5. Pilot's sunvisor
6. Magnetic compass
7. Windshield wipers
8. Avionics control panel
9. Copilot's storm window lock
10. Copilot's rudder pedals
11. Copilot's control wheel
12. Pilot's rudder pedals
13. Pilot's control wheel
14. External mirror actuation knob
15. Plotting board storage container
16. Pilot's seat
17. Drift sight window

Figure 2-10. Cockpit **RU-21D** *(Sheet 1 of 2)*



18. Shoulder harness lock lever	26. Right subpanel
19. Pilot's storm window lock	27. Oxygen regulator control panel
20. Free air temperature gage	28. Copilot's seat
21. Annunciator panel	29. Utility pockets
22. Overhead control panel	30. Control pedestal extension
23. Copilot's sunvisor	31. Left subpanel
24. Copilot's plotting board	32. 8-day clock
25. Copilot's circuit breaker and fuse panel	33. Oxygen system gage

Figure 2-10. Cockpit **RU-21D** *(Sheet 2 of 2)*



1. Fire detection system test switch
2. Landing gear down position indicator lights
3. Condition levers
4. Wing flap switch
5. Flare/chaff dispenser control panel
6. ADF control panel
7. VOR control panel
8. Cockpit access assist step
9. Landing gear emergency extension placard
10. HF control panel
11. UHF control panel
12. Autopilot back course switch
13. Aileron tab control and position indicator
14. Elevator tab control wheel and position indicator
15. Power levers

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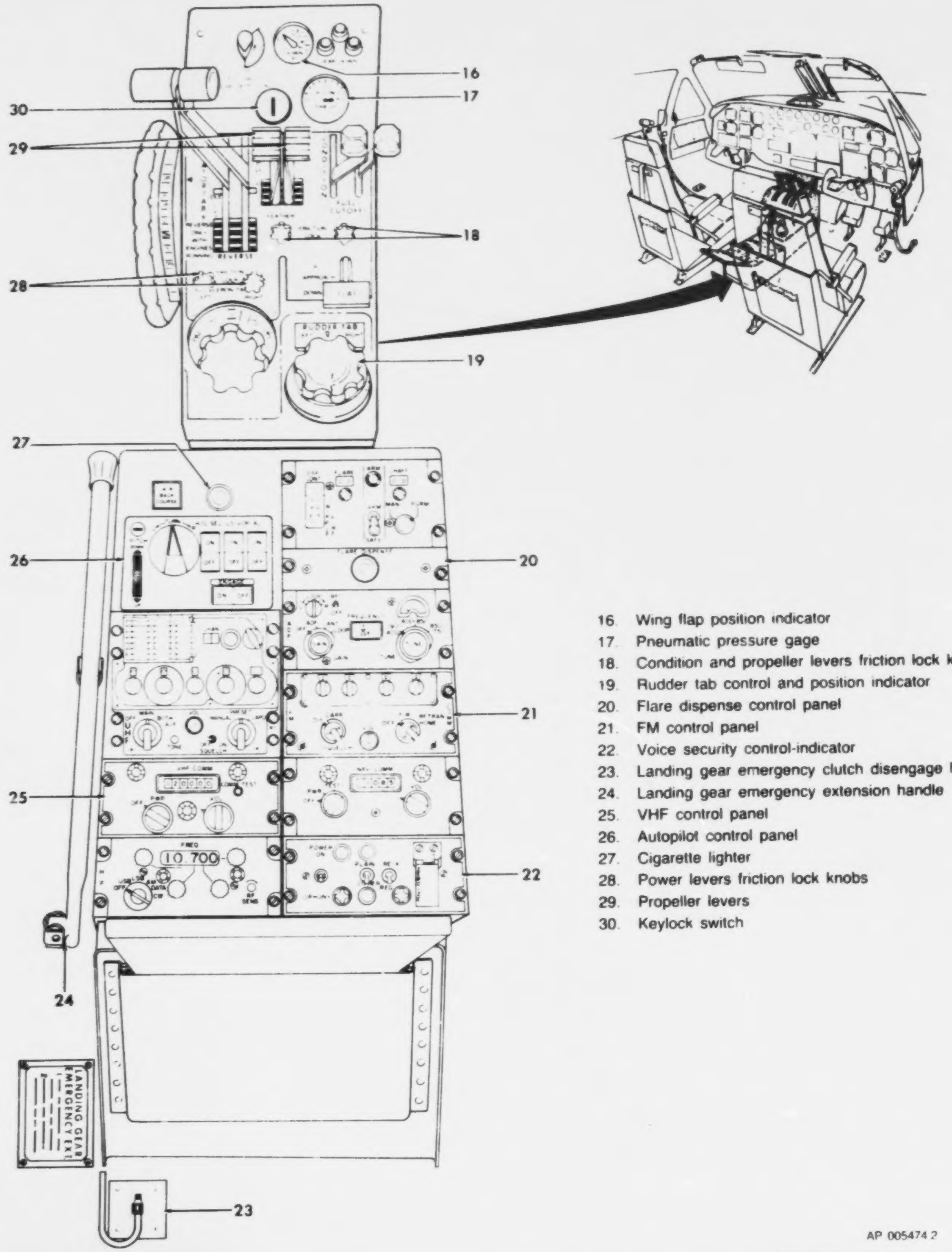
Figure 2-11. Control Pedestal and Landing Gear Emergency Extension Controls **RU-21A** *(Sheet 1 of 2)*



16. Wing flap position indicator
17. Pneumatic pressure gage
18. Condition and propeller levers friction lock knobs
19. Rudder tab control and position indicator
20. Flare dispense control panel
21. FM control panel
22. Voice security control-indicator
23. Landing gear emergency clutch disengage handle
24. Landing gear emergency extension handle
25. VHF control panel
26. Autopilot control panel
27. Cigarette lighter
28. Power levers friction lock knobs
29. Propeller levers
30. Keylock switch

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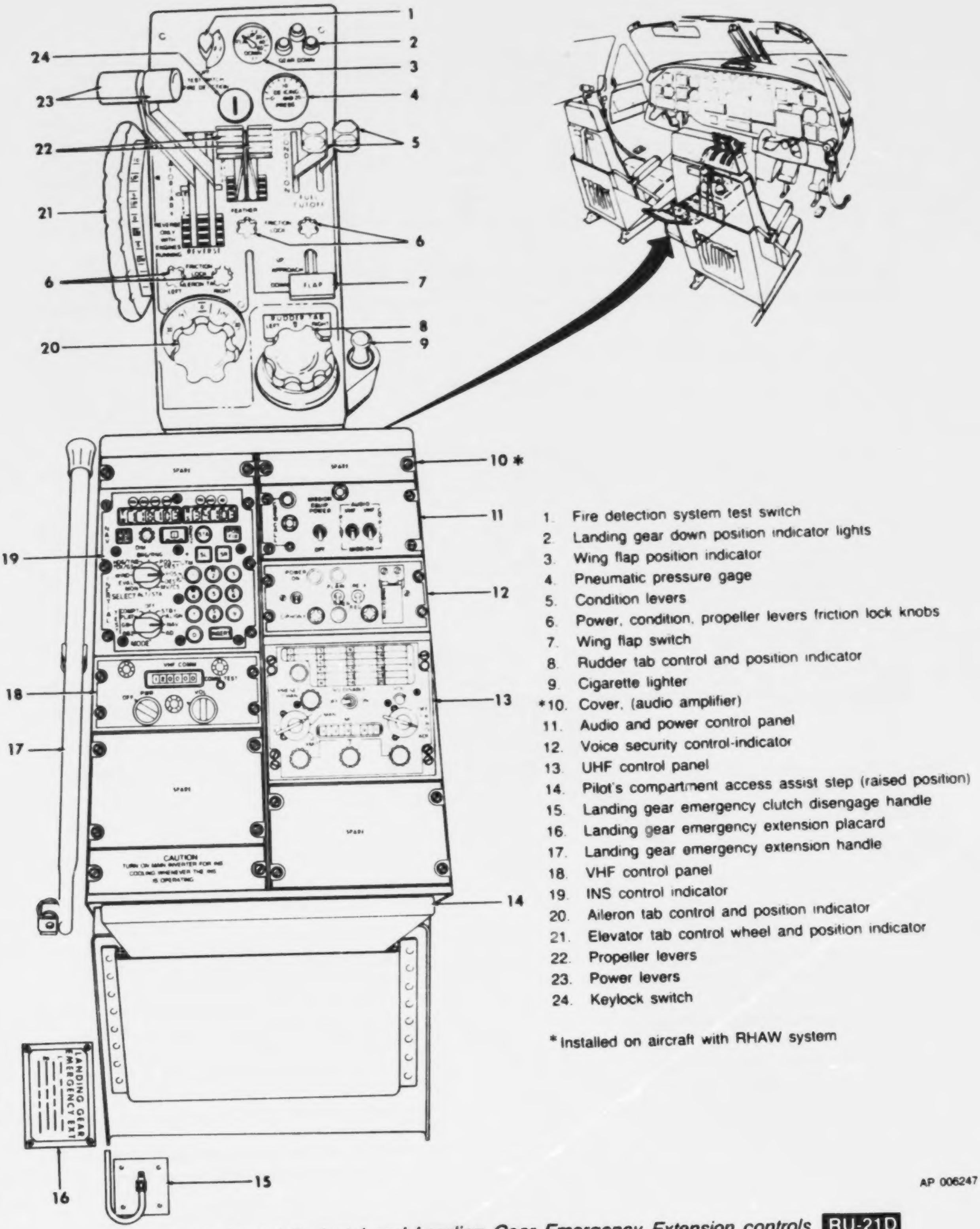
Figure 2-11. Control Pedestal and Landing Gear Emergency Extension Controls **RU-21A** *(Sheet 2 of 2)*



1. Fire detection system test switch
2. Landing gear down position indicator lights
3. Wing flap position indicator
4. Pneumatic pressure gage
5. Condition levers
6. Power, condition, propeller levers friction lock knobs
7. Wing flap switch
8. Rudder tab control and position indicator
9. Cigarette lighter

*10. Cover, (audio amplifier)

11. Audio and power control panel
12. Voice security control-indicator
13. UHF control panel
14. Pilot's compartment access assist step (raised position)
15. Landing gear emergency clutch disengage handle
16. Landing gear emergency extension placard
17. Landing gear emergency extension handle
18. VHF control panel
19. INS control indicator
20. Aileron tab control and position indicator
21. Elevator tab control wheel and position indicator
22. Propeller levers
23. Power levers
24. Keylock switch

*Installed on aircraft with RHAW system

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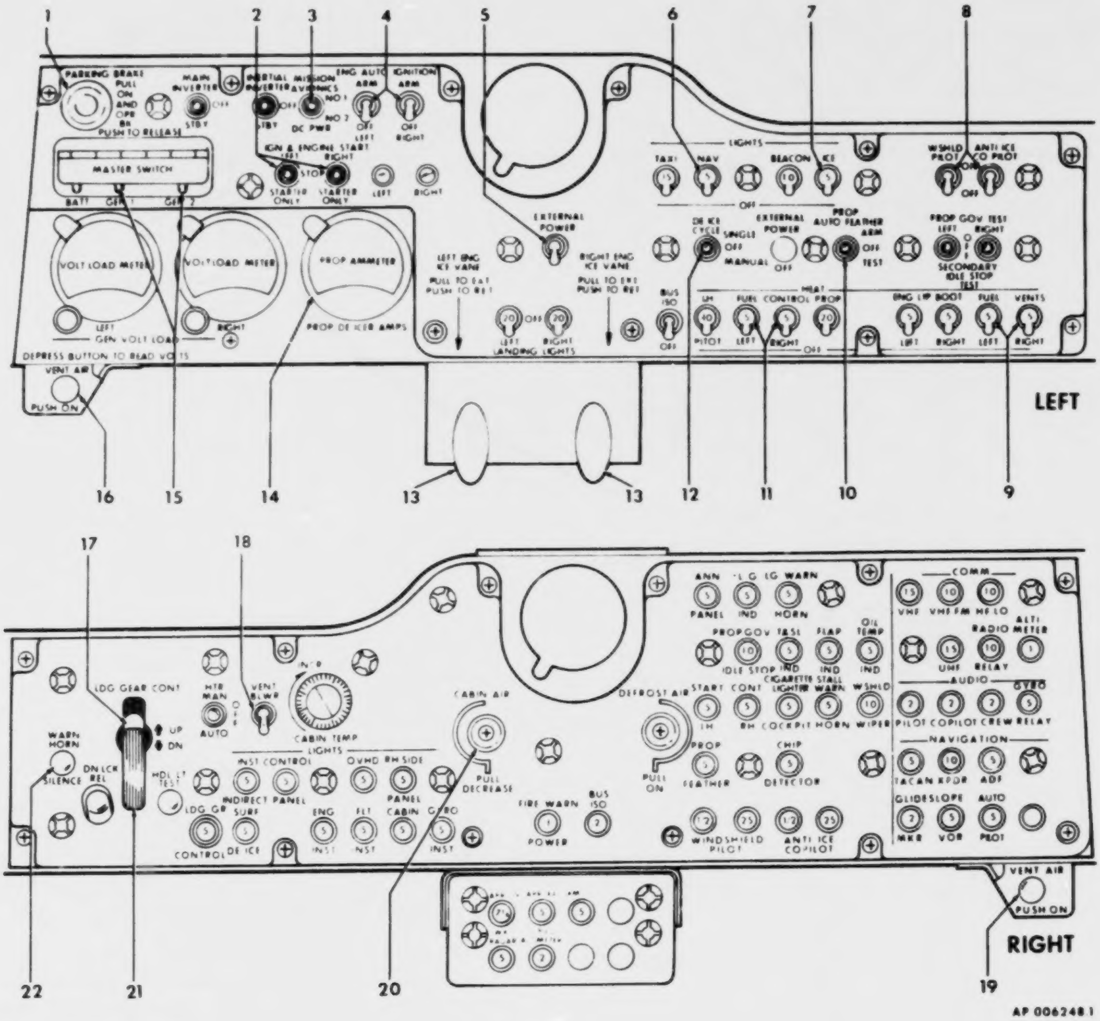
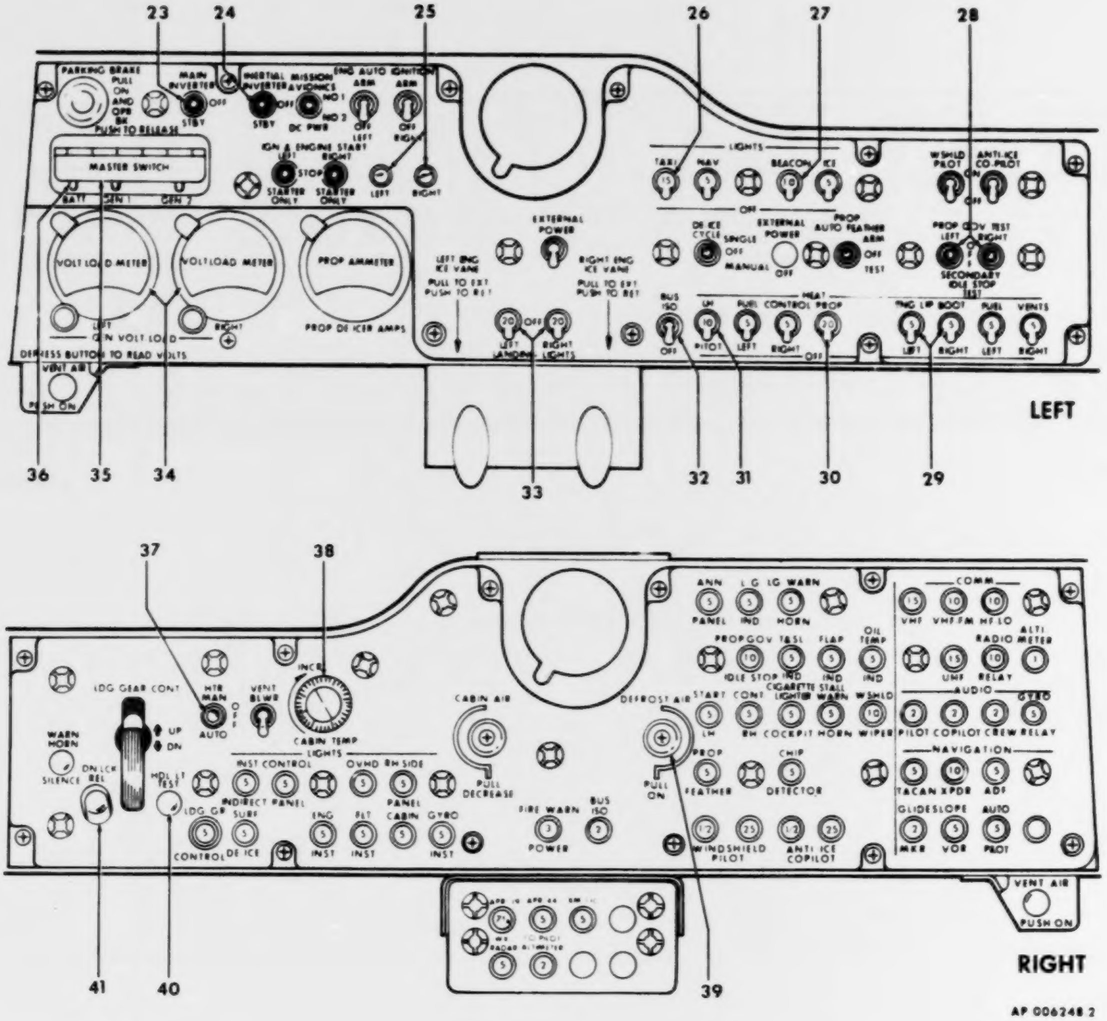
Figure 2-12. Control Pedestal and Landing Gear Emergency Extension controls **RU-21D**



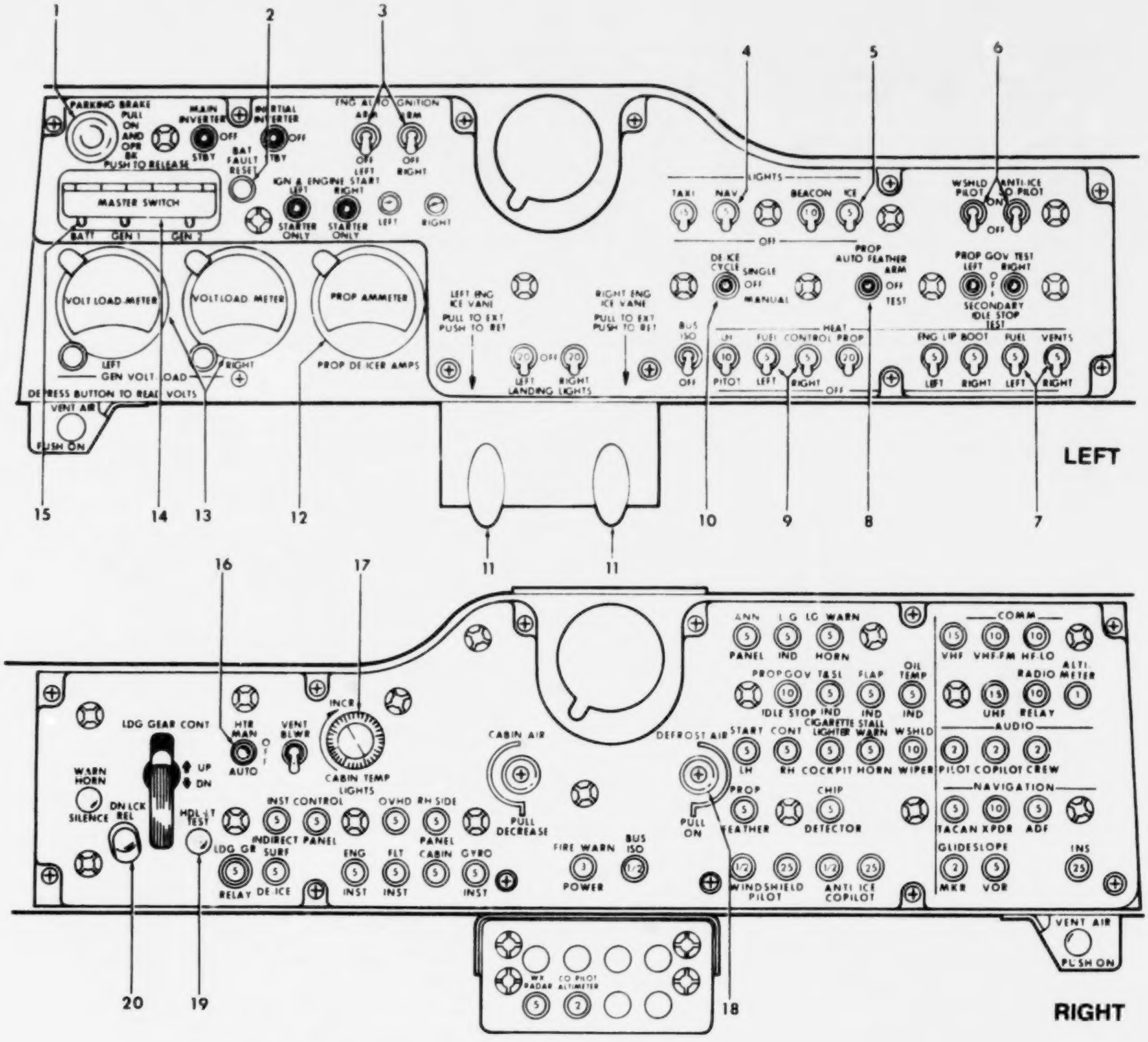
1. Parking brake handle
2. Ignition & engine start/starter only switches
3. Mission avionics DC power switch
4. Engine autoignition switches
5. External AC power switch
6. Navigation lights switch
7. Ice lights switch
8. Windshield anti-ice switches
9. Fuel vent heat switches
10. Propeller autofeather switch
11. Fuel control heat switches
12. De-ice cycle switch
13. Engine ice vane control handles
14. Propeller ammeter
15. Generator switches
16. Pilot's air inlet control
17. Landing gear control handle
18. Ventilation blower switch
19. Copilot's air inlet control
20. Cabin air control
21. Landing gear position warning lights (inside handle)
22. Landing gear warning horn silencer button

Figure 2-13. Subpanels **RU-21A** *(Sheet 1 of 2)*



23. Main inverter switch
24. Inertial inverter switch
25. Engine autoignition arm lights
26. Taxi lights switch
27. Beacon lights switch
28. Propeller governor test and secondary idle stop test switches
29. Engine lip boot heat switches
30. Propeller heat switch
31. Pitot heat switch
32. Bus isolation switch
33. Landing light switches
34. Volt-loadmeters
35. Master switch gang bar
36. Battery switch
37. Heater control switch
38. Heater temperature control rheostat
39. Defrost air control
40. Landing gear handle light test switch
41. Landing gear handle down lock release

Figure 2-13. Subpanels **RU-21A** *(Sheet 2 of 2)*



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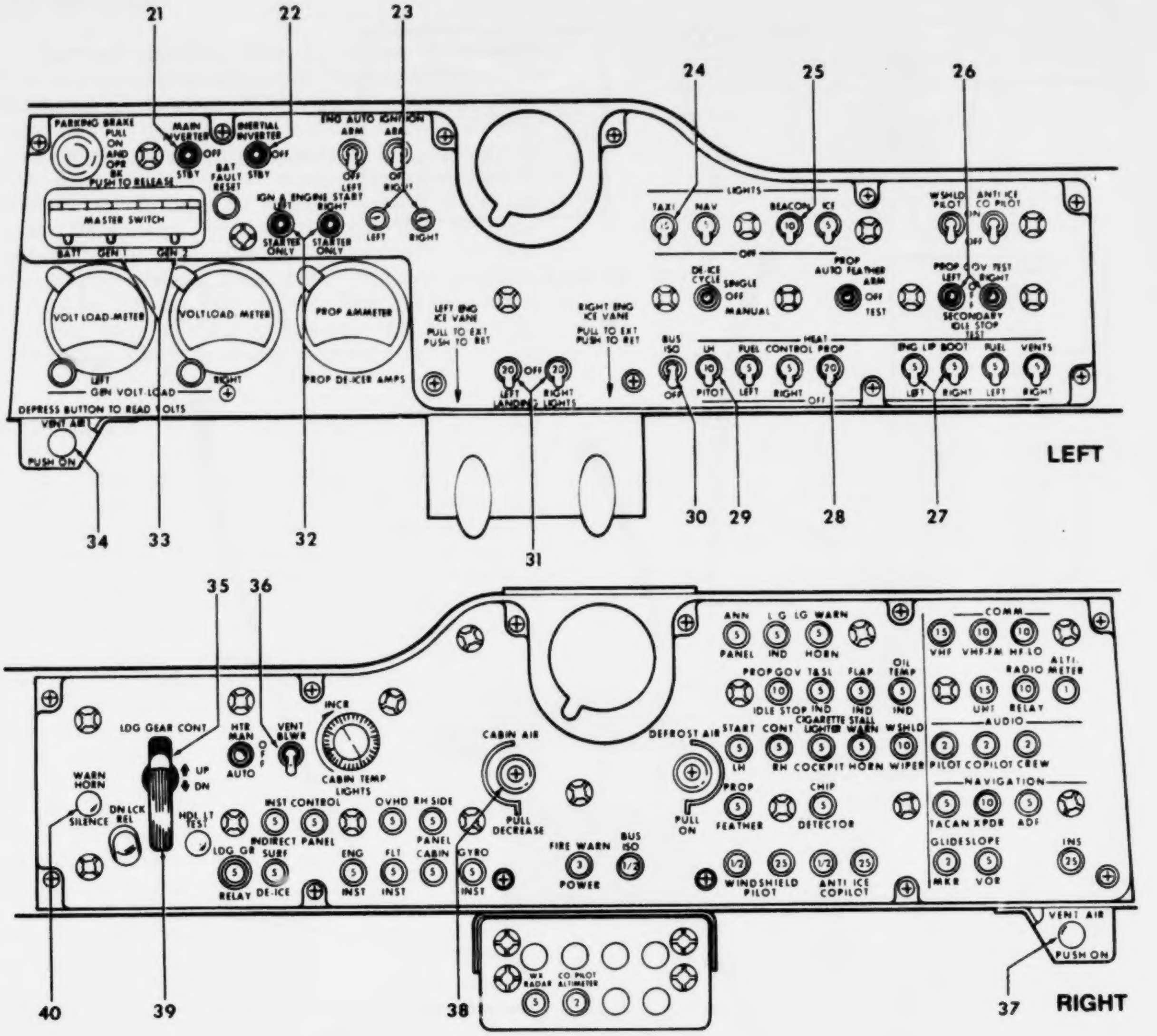
1. Parking brake handle
2. Battery fault reset switch
3. Engine autoignition switches
4. Navigation lights switch
5. Ice lights switch
6. Windshield anti-ice switches
7. Fuel vent heat switches
8. Propeller autofeather switch
9. Fuel control heat switches
10. De-ice cycle switch
11. Engine ice vane control handles
12. Propeller ammeter
13. Volt-loadmeters
14. Master switch gang bar
15. Battery switch
16. Heater control switch
17. Heater temperature control rheostat
18. Defrost air control handle
19. Landing gear handle light test switch
20. Landing gear handle down lock release

Figure 2-14. Subpanels **RU-21D** *(Sheet 1 of 2)*



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21. Main inverter switch
22. Inertial inverter switch
23. Engine autoignition arm lights
24. Taxi lights switch
25. Beacon lights switch
26. Propeller governor test and secondary idle stop test switches
27. Engine lip boot beat switches
28. Propeller heat switch
29. Pitot heat switch
30. Bus isolation switch
31. Landing light switches
32. Ignition and engine start/starter only switches
33. Generator switches
34. Pilot's air inlet control
35. Landing gear control handle
36. Ventilation blower switch
37. Copilot's air inlet control
38. Cabin air control handle
39. Landing gear position warning lights (inside handle)
40. Landing gear warning horn silencer button

Figure 2-14. Subpanels **RU-21D** *(Sheet 2 of 2)*

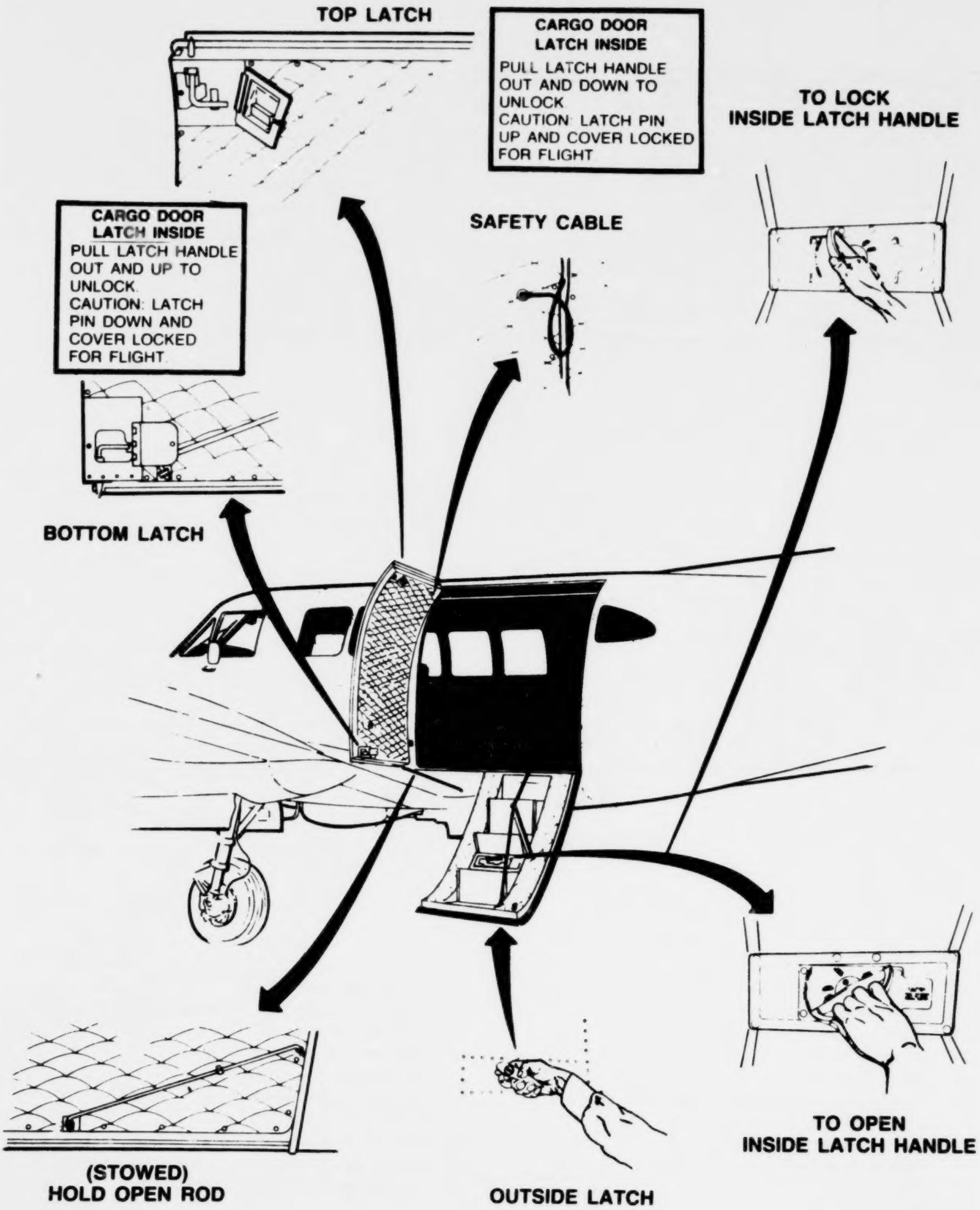

TOP LATCH
CARGO DOOR LATCH INSIDE
PULL LATCH HANDLE OUT AND DOWN TO UNLOCK
CAUTION: LATCH PIN UP AND COVER LOCKED FOR FLIGHT
TO LOCK INSIDE LATCH HANDLE
CARGO DOOR LATCH INSIDE
PULL LATCH HANDLE OUT AND UP TO UNLOCK.
CAUTION: LATCH PIN DOWN AND COVER LOCKED FOR FLIGHT.
SAFETY CABLE
BOTTOM LATCH
TO OPEN INSIDE LATCH HANDLE
(STOWED) HOLD OPEN ROD
OUTSIDE LATCH
AV 094942

Figure 2-15. Main Entrance and Cargo Doors

2-12. Windows.

Forward visibility from the cockpit is provided by a two piece electrothermal windshield made of laminated plate glass. Side visibility for the pilot and copilot is provided by a window made of acrylic on each side of the cockpit. Immediately forward of each side window is a triangular-shaped storm window which may be opened during flight or ground operation. Windows are provided on each sidewall of the cabin. On RU-21D aircraft, all right side cabin windows have cover curtains and are blocked by the mission console. The left side cabin windows have curtain provisions which may be adjusted to admit or exclude outside light.

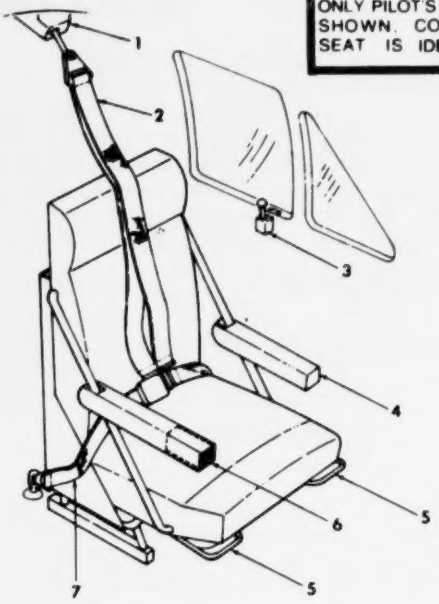
2-13. Seats.

a. Pilot and Copilot Seats. Aircraft seating accommodations for the pilot and copilot are adjustable, chair-type units (fig. 2-16). An entry aisle separates the two seats. Both seats can be adjusted fore and aft, and vertically. The fore and aft adjustment handle is located beneath the bottom front inboard corner of each seat. Pulling up on the handle allows the seat to move fore or aft. The vertical adjustment handle is located beneath the bottom front outboard corner of each seat. Pulling up on the handle, allows the seat to move up or down.

b. Seat Belts and Shoulder Harnesses – Pilot's and Copilot's Seats. Pilot and copilot seats are each equipped with a seat belt and shoulder harness. Each belt attaches to two floor disconnect fittings located aft of the seat. Pilot and copilot shoulder harnesses incorporate an inertial reel to provide crash restraint. The inertia reel will lock automatically under a 2 "G" impact, or may be manually locked if desired.

NOTE

ONLY PILOT'S SEAT IS SHOWN. COPILOT'S SEAT IS IDENTICAL



AV 111167

1. Inertia reel
2. Shoulder harness
3. Inertia reel lock
4. Arm rest
5. Seat adjustment handle
6. Ash tray
7. Seat belt

Figure 2-16. Pilot and Copilot Seats

Section II. EMERGENCY EQUIPMENT

2-14. Description.

The equipment covered in this section includes all emergency equipment, except that which forms part of a complete system. For example, landing gear system, etc. For the operation of emergency exits and for location of all emergency equipment, refer to chapter 9.

2-15. Hand-Operated Fire Extinguishers.

WARNING

Exposure to high concentrations of monobromotrifluoromethane (CF_3Br) or decomposition products should be avoided. The liquid should not be allowed to come into contact with the skin, as it may cause frost bite or low temperature burns because of its very low boiling point.

One hand-operated, monobromotrifluoromethane (CF_3Br) type fire extinguisher is mounted beneath the copilot's seat (fig. 9-1). A second extinguisher unit of the same type mounted on the floor of the aft cabin just aft of the main entrance doorway (fig. 9-1). An extinguisher is removed by releasing a latch on the retaining strap. The extinguishers are charged to a pressure of 150 to 170 PSI, and emit a forceful stream. Use an extinguisher with care within the limited area of the cabin to avoid severe splashing.

NOTE

Engine fire extinguisher systems are not installed.

2-16. First Aid Kits.

Five first aid kits are provided in the aircraft (fig. 9-1). One kit is installed on the backside of the pilot's and copilot's seat and three installed on the aft cabin bulkhead.

2-17. Fire Axe.

The fire axe is located under the copilot's seat in the cockpit.

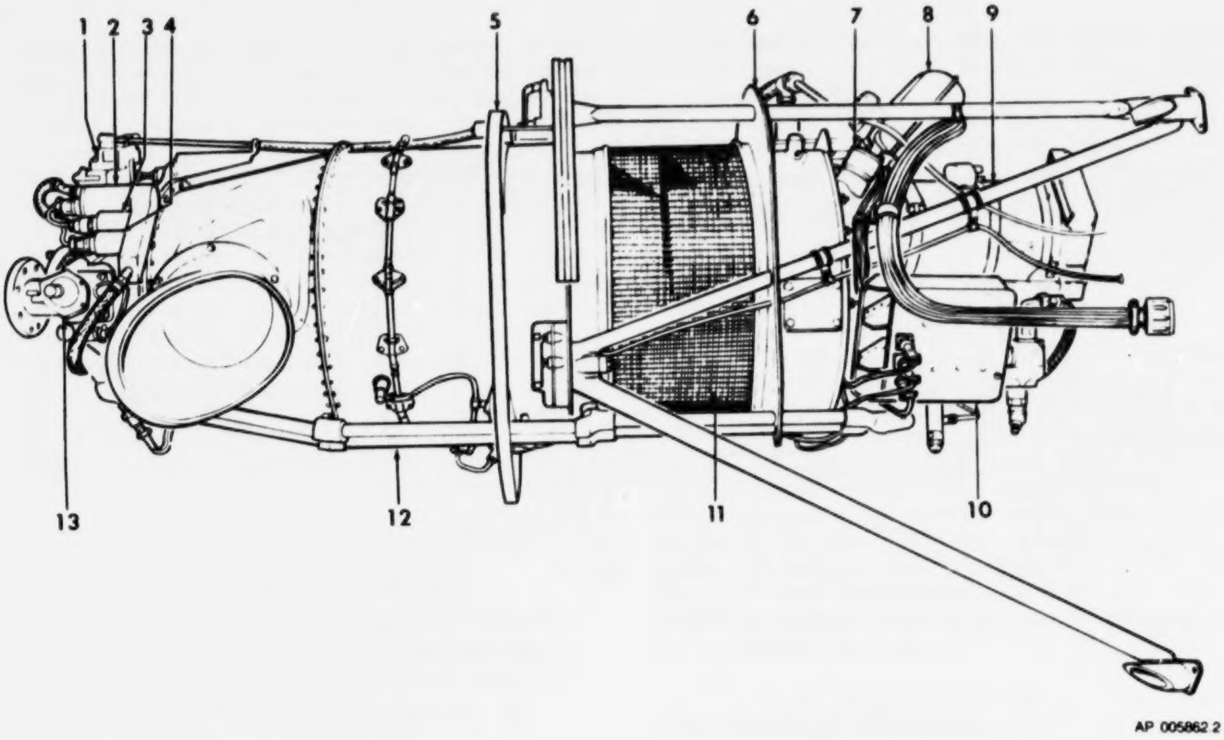
Section III. ENGINES AND RELATED SYSTEMS

2-18. Description.

The aircraft is powered by two T74-CP-700 turboprop engines (fig. 2-17) rated at 550 SHP. This engine is a reverse flow, free turbine type, employing a three-stage axial and a single-stage centrifugal compressor assembled as an integral unit. A large area circular steel screen around the air intake at the rear of the gas generator case precludes foreign object ingestion by the compressor. The combustion chamber is of the reverse flow type and consists primarily of an annular heat-resistant steel liner open at one end. The single-stage compressor turbine and free power turbine are in line with each other and are counter-rotating. The single-stage power turbine is connected through a two-stage planetary reduction gearbox to a flanged propeller shaft. For the purpose of engine RPM/power ratio familiarization and computation, compressor turbine rotational speed (RPM) will be referred to as N_1, and the propeller speed N_2 as actual indicated tachometer RPM. The engine driven accessories other than the primary, overspeed and power turbine governors, and N_1 tachometer-generator, are mounted on the accessory gearbox and are driven from the compressor shaft. The oil tank, filler cap and dip stick are an integral part of the compressor air inlet and the accessory section.

2-19. Engine Compartment Cooling.

The forward engine compartment including the accessory section is cooled by air entering around the exhaust stub cutouts, the gap between the propeller spinner and forward cowling, and exhausting through louvers located behind the exhaust stubs.



1. Propeller governor
2. Torque pressure transmitter
3. Autoignition pressure switch
4. Autofeather pressure switch
5. Center fireseal
6. Rear fireseal
7. Oil filler cap and dipstick
8. Oil-to-fuel heat exchanger
9. Starter/generator
10. Ignition regulator box
11. Air intake screen
12. Oil scavenge tubes
13. Propeller overspeed governor

Figure 2-17. T74-CP-700 Engine (Sheet 1 of 2)

2-20. Air Induction Systems – General.

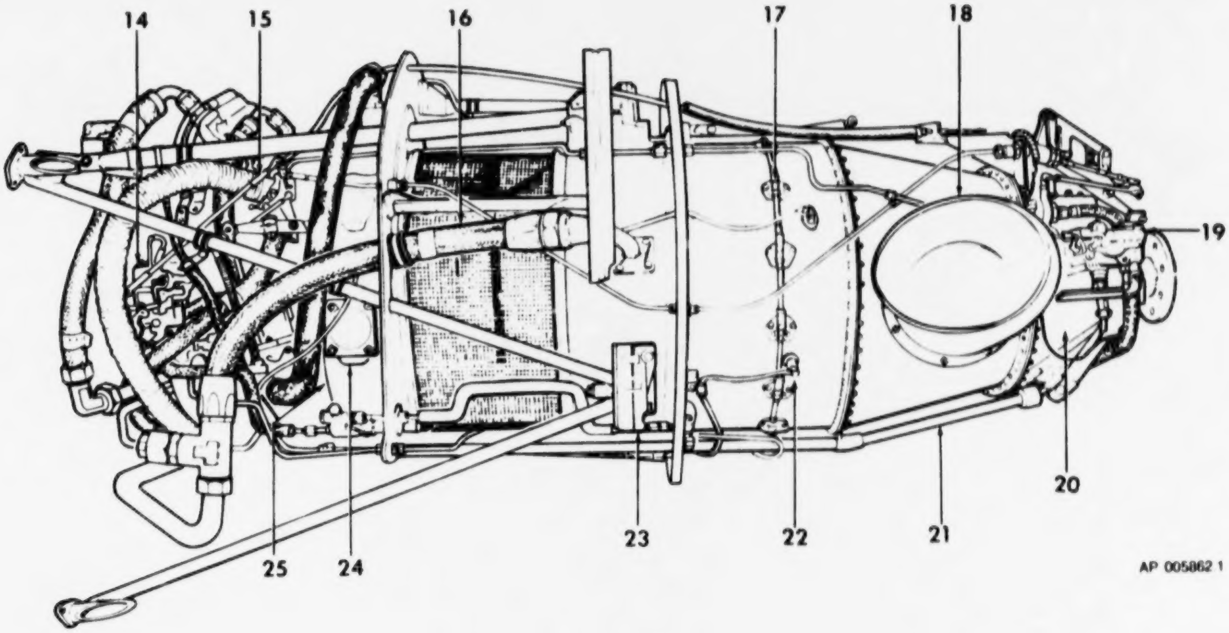
Each engine receives ram air ducted from an air scoop located within the lower section of the forward nacelle. Each oil cooler uses ram air secured by a separate air scoop attached to the lower section of the nacelle. Special components of the engine induction system protect the power plant from icing and foreign object damage.

2-21. Foreign Object Damage Control.

The engine has an integral air inlet screen designed to obstruct objects large enough to damage the compressor.

2-22. Power Plant Ice Protection Systems.

a. Inertial Separators. An inertial separation system is built into each engine air inlet to prevent moisture particles from entering the engine inlet plenum under freezing conditions. This is done by introducing a sudden turn in the airstream to the engine, causing the moisture particles to continue on undeflected because of their greater momentum and to be discharged overboard. During normal operation, a movable vane is raised out of the direct ram airstream. For cold weather (5°C or below) operation in visible moisture, it should be lowered into the airstream. The anti-ice vanes are operated by individual T-handle, push-pull controls, located below the left subpanel. The controls are placarded



14.	Fuel control unit	20.	Reduction gearbox housing
15.	Fuel control unit control rod	21.	Oil pressure tube
16.	Bleed air line	22.	Ignitor plug
17.	Fuel manifold	23.	Engine mount
18.	Exhaust	24.	Oil filter cover
19.	Power turbine governor	25.	Accessory gearbox housing

Figure 2-17. T74-CP-700 Engine (Sheet 2 of 2)

LEFT ENG ICE VANE, PULL TO EXT, PUSH TO RET, RIGHT ENG ICE VANE, PULL TO EXT, PUSH TO RET (fig. 2-13 or 2-14). Vane position during operation is indicated by the position of the T-handles, and by a slight decrease in torque with the engine ice protection controls extended. The vanes should be either fully retracted or fully extended; there are no intermediate positions.

b. Engine Lip Boot Heat. The engine air inlet lip boots are electrically heated to prevent the formation of ice and consequent distortion of the airflow. The boots are operated by the two 5-ampere circuit breaker switches on the pilot's subpanel placarded: ENG LIP BOOT, LEFT-RIGHT. The circuit is connected through the right landing gear safety switch and is therefore operable only during flight. The circuit is protected by two 25-ampere circuit breakers, placarded LIP ANTI-ICE, LH-RH, located on the copilot's circuit breaker panel (fig. 2-29 or 2-31). During flight, when icing conditions are anticipated, position both ENG LIP BOOT heat switches ON (up), (fig. 2-7). Continue use as required and shut off when icing conditions are no longer present or anticipated.

c. Fuel Control Heat. Each fuel control's temperature compensating line is protected against ice by electrically heated jackets. Power is supplied to each fuel control air line heater by two switches, placarded FUEL CONTROL HEAT, LEFT AND RIGHT on the pilot's subpanel. Fuel control heat should be turned on before all flight operations.

2-23. Engine Fuel Control System.

a. Description. The fuel control system consists of an engine-driven fuel pump, a fuel control unit, and a fuel nozzle manifold. An automatic fuel dump valve and two drain valves are provided to drain residual fuel from the engine after shutdown or after a discontinued start.

b. Fuel Control Unit. One fuel control unit is on the accessory case of each engine. This unit is a hydro-mechanical metering device which determines the proper fuel schedule for the engine to produce the amount of power requested by the relative position of its power lever. The control of developed engine power is accomplished by adjusting the engine compressor turbine (N_1) speed. N_1 speed is controlled by varying the amount of fuel injected into the combustion chamber through the fuel nozzles. All fuel control operations are made by movement of the power and condition levers for a specific engine. Engine shutdown is accomplished by moving the appropriate condition lever to the full aft, FUEL CUT-OFF position, which shuts off the fuel supply.

2-24. Power Levers.

CAUTION

Moving the power levers into reverse range without the engines running may result in damage to the reverse linkage mechanisms.

Two power levers are located on the control pedestal (fig. 2-11, 2-12). These levers regulate power in the reverse, idle, and forward range, and operate so that forward movement increases engine power. Power control is accomplished through adjustment of the N_1 speed governor in the fuel control unit. Power is increased when N_1 RPM is increased. The power levers also control propeller reverse pitch. Distinct movement (pulling up and then aft on the power lever) by the pilot is required for reverse thrust. Placarding below the lever travel slots reads POWER. Upper lever travel range is designated INCR (increase), supplemented by an arrow pointing forward. Lower travel range is marked IDLE, LIFT and REVERSE. A placard below the lever slots reads: CAUTION - REVERSE ONLY WITH ENGINES RUNNING.

2-25. Condition Levers.

Two condition levers are located on the control pedestal (fig. 2-11, 2-12). Each lever starts or stops the fuel supply, and controls the idle speed for its engine. The levers have three placarded positions: FUEL CUTOFF, LO IDLE, and HIGH IDLE. In the FUEL CUTOFF position, the condition lever controls the cutoff function of its engine-mounted fuel control unit. From LO IDLE to HIGH IDLE, they control the governors of the fuel control units to establish minimum fuel flow levels. LO IDLE position sets the fuel flow rate to attain 51% to 54% (at sea level) minimum N_1 and HIGH IDLE position sets the rate to attain 70% to 73% minimum N_1. The power lever for the corresponding engine can select N_1 from the respective idle setting to maximum power. An increase in low idle N_1 will be experienced at higher field elevation.

2-26. Friction Lock Knobs.

Four friction lock knobs are located on the control pedestal to adjust friction drag for the engine and propeller control levers. One knob is below the propeller levers, one below the condition levers, and two under the power levers. When a knob is rotated clockwise, friction restraint is increased opposing movement of the affected lever as set by the pilot. Counterclockwise rotation of a knob will decrease friction drag thus permitting free and easy lever movement. Two FRICTION LOCK placards are located on the pedestal adjacent to the knobs (fig. 2-11, 2-12).

2-27. Engine Fire Detection System.

A flame surveillance system is installed on each engine to detect external engine fire and provide alarm to the pilot. Both nacelles are monitored, each having a control amplifier and three detectors. Electrical wiring connects all sensors and control amplifiers to DC power and to the cockpit audio and visual alarm units. In each nacelle, one detector monitors the forward nacelle, a second monitors the upper accessory area, and a third the lower accessory area.

a. Fire emits an infrared radiation that will be sensed by the detector which monitors the area of origin. Radiation exposure activates the relay circuit of a control amplifier which causes signal power to be sent to cockpit alarms. An activated surveillance system will return to the standby state after the fire is out. The system includes a functional test switch and has circuit protection through the FIRE WARN POWER circuit breaker.

b. Warning of internal nacelle fire is provided as follows: A warning horn sounds in the cockpit; simultaneously the red FAULT WARN light on the instrument panel starts flashing. These alarms are accompanied by the continuous illumination of a red LH FIRE WARNING or RH FIRE WARNING light also on the annunciator panel (fig. 2-36, 2-37). Fire detector circuits are protected by a single 3-ampere circuit breaker, placarded FIRE WARN POWER, located on the right subpanel (fig. 2-13, 2-14).

c. An erroneous indication of engine fire may be encountered if an engine cowling is not closed properly, or if the aircraft is headed toward a strong external light source. In this circumstance, close the cowling and/or change the aircraft heading away from the light source.

d. One rotary switch placarded TEST SWITCH FIRE DETECTION - OFF, 1, 2, 3, on the control pedestal, is provided to test the engine fire detection system (fig. 2-11, 2-12). Before checkout, battery power must be on and the FIRE DETECTOR circuit breaker must be in. Switch position 1, checks the area forward of the air intake of each nacelle, including circuits to the cockpit alarm and indication devices. Switch position 2, checks the circuits for the upper accessory compartment of each nacelle. Switch position 3, checks the circuits for the lower accessory compartment of each nacelle. Each numbered switch position will initiate the cockpit alarm and indications previously described.

2-28. Oil Supply System.

a. The engine oil tank is integral with the air-inlet casting located forward of the accessory gearbox. Oil for propeller operation, lubrication of the reduction gearbox and engine bearings is supplied by an external line from the high pressure pump. Two scavenge lines return oil to the tank from the propeller reduction gearbox. A non-congealing external oil cooler keeps the engine oil temperature within the operating limits. The capacity of each engine oil tank is 9.2 quarts and includes an expansion space of 0.72 quarts. The total system capacity for each engine, which includes the oil tank, oil cooler, lines, etc., is 14 quarts - of which 6 quarts are usable. The oil level is indicated by a dipstick attached to the oil filler cap. For oil grade, specification and servicing points, refer to Section XII, Servicing.

b. The oil system of each engine is coupled into a heat exchanger unit (radiator) of fin-and-tube design. These exchanger units are the only airframe mounted part of the oil system and are attached to the nacelles below the engine air intake. Each heat exchanger incorporates a thermal bypass which assists in maintaining oil at the proper temperature range for engine operation.

2-29. Engine Chip Detection System.

A magnetic chip detector is installed in the bottom of each engine reduction gearbox to warn the pilot of oil contamination and possible engine failure. The sensor is an electrically insulated gap immersed in the oil functioning as a normally-open switch. If a large metal chip or a mass of small particles bridge the detector gap a circuit is completed, sending a signal to illuminate an annunciator panel yellow light placarded CHIP DETECTED LEFT ENGINE or CHIP DETECTED RIGHT ENGINE and the FAULT WARN light (fig. 2-36, 2-37). Chip detector circuits are protected by a single 5-ampere circuit breaker, placarded CHIP DETECTOR, on the right subpanel (fig. 2-13, 2-14).

2-30. Engine Ignition System.

a. Description. The basic ignition system consists of a current regulator unit, two igniter plugs, two shielded ignition cables, pilot-controlled IGNITION & ENGINE START/STARTER ONLY switches and the IGNITER POWER switches or autoignition switches, if installed. Activation of an IGNITION & ENGINE START switch will cause coils in the respective igniter plugs to heat, igniting the fuel and air mixture sprayed into the combustion chamber by the fuel nozzles. The ignition system is activated for ground and air starts, but is switched off after combustion light up.

b. Ignition and Engine Start Switches. One three-position toggle switch for each engine on the left subpanel, will initiate starter motoring and ignition in the IGNITION & ENGINE START position, or will motor the engine in the STARTER ONLY position (fig. 2-13, 2-14). The switches are placarded LEFT and RIGHT to designate the appropriate engine. The IGNITION & ENGINE START switch position completes the starter circuit for engine rotation, energizes the igniter plugs for fuel combustion, and activates the corresponding IGN IND light on the annunciator panel. At STOP position (centered) the switch is OFF. Two 20-ampere circuit breakers on the copilot's circuit breaker and fuse panel, placarded IGNITORS - LH and RH, protect ignition circuits. Two 5- or 15-ampere circuit breakers on the right subpanel, placarded START CONT - LH and RH, protect starter control circuits (fig. 2-31, 2-32).

2-31. Autoignition System.

If armed the autoignition system automatically provides combustion re-ignition of either engine should accidental flameout occur. The system is not essential to normal engine operation, but is used to reduce the possibility of power loss due to icing or other conditions. Each engine has a separate autoignition control switch, a green PRESS-TO-TEST light, and a yellow indicator on the annunciator panel. Autoignition is accomplished by energizing the two igniter heating elements in each engine.

a. Autoignition Switches. Two switches placarded ENG AUTOIGNITION, LEFT and RIGHT with positions ARM and OFF, are located on the left subpanel (fig. 2-13, 2-14) ARM position initiates a readiness mode for the autoignition system of the corresponding engine. OFF position disarms the system. Each switch is protected by a corresponding START CONT, LH or RH circuit breaker of 5- or 15-amperes on the right subpanel (fig. 2-13, 2-14).

b. Autoignition Lights. Two green press-to-test lights are positioned below autoignition switches (fig. 2-13, 2-14). Each light, although not placarded, is associated only with the switch directly above it and will illuminate when that switch is placed in the ARM position. Illumination of a light indicates that the autoignition system is in a "ready condition". If an ARMED autoignition system changes from a "ready condition" to an "operating condition" (energizing the two igniter elements in an engine) the green light will extinguish and a corresponding yellow annunciator panel light will illuminate. The annunciator panel light is placard L or R IGN ON and indicates that the igniters are energized. The autoignition system is triggered from a "ready condition" to an "operating condition" when engine torque drops below 12 PSI (350 to 450 ft-lbs torque). Therefore, when an autoignition system is ARMED, the igniters will be energized continuously during the time when an engine is operating at a level below 12 PSI (350 to 450 ft-lbs torque). The autoignition lights are protected by 5- or 15- ampere START CONT, LH or RH circuit breakers on the right subpanel (fig. 2-13, 2-14).

c. Ignition-On Indicators. The ignition "on" state is confirmed by an illuminated yellow function indicator on the annunciator panel placarded LH or RH IGN IND (fig. 2-36, 2-37).

2-32. Engine Starter-Generators.

One starter-generator is mounted on each engine accessory drive section. Each is able to function either as a starter or as a generator. In starter function, 28 volts DC is required to power rotation. In generator function, each RU-21D unit is capable of 300-amperes DC output and each RU-21A unit is capable of 250-amperes DC output. When the starting function is selected, the starter-generator receives power through the respective 5-ampere start-control circuit breakers on the right subpanel from either the aircraft battery or an external power source. When the generating function is selected, the starter generator provides electrical power to its respective bus. For additonal description of the starter-generator system, refer to Section IX.

2-33. Engine Instruments.

Instruments which display engine conditions or state of operation are discussed in the following paragraphs. Engine instruments are vertically mounted on the left-center section of the instrument panel (fig. 2-36, 2-37).

a. Interstage Turbine Temperature Indicators. Two interstage turbine temperature (ITT) gages on the instrument panel are calibrated in degrees Celsius units (fig. 2-36, 2-37). Each gage is connected to ten thermocouple probes located in the hot gasses between the turbine wheels. The ITT gages register the temperature present between the compressor turbine and power turbine for the corresponding engine.

b. Engine Torquemeters. Two torquemeters on the instrument panel indicate torque applied to the propeller shafts of the respective engines (fig. 2-36, 2-37). Each gage shows torque by foot-pound measure using 100 pound graduations and is actuated by an electrical signal from a pressure sensing system located in the respective propeller reduction gear case. Torquemeters are protected separately by a 1-ampere circuit breaker, placarded TORQUEMETER LH, RH, on the copilot's circuit breaker panel (fig. 2-29, 2-31).

c. Turbine Tachometers. Two tachometers on the instrument panel register compressor turbine RPM (N_1) for the respective engine (fig. 2-36, 2-37). These indicators register turbine RPM as a percentage of maximum gas generator RPM. Each instrument is slaved to a tachometer generator attached to the respective engine.

d. Oil Pressure Indicators. Two gages on the instrument panel register oil pressure in PSI as taken from the delivery side of the main oil pressure pump (fig. 2-36, 2-37). Each gage is connected to a pressure transmitter installed on the respective engine. Both instruments are protected by a single, 1-ampere circuit breaker, placarded

OIL PRESS, on the copilot's circuit breaker panel (fig. 2-29, 2-31).

e. Oil Temperature Indicators. One oil temperature gage on the instrument panel is provided for each engine (fig. 2-36, 2-37). These instruments are connected to a thermal sensor unit attached to the respective engines. Each gage registers oil temperature in °C as it leaves the delivery side of the oil pressure pump. Both gages are protected by a single 5-ampere circuit breaker, placarded OIL TEMP IND, on the right subpanel (fig. 2-13, 2-14).

f. Fuel Flow Indicators. Two gages on the instrument panel register the rate of flow for consumed fuel as measured by sensing units coupled into the fuel supply lines of the respective engines (fig. 2-36, 2-37). The fuel flow indicators are calibrated in increments of hundreds of pounds per hour. Both circuits are protected by a single, 1-ampere circuit breaker, placarded FUEL FLOW, on the copilot's circuit breaker and fuse panel (fig. 2-29, 2-31).

g. Fuel Pressure Indicators. Two gages on the instrument panel register boost pump pressure sensed by pressure transmitters (fig. 2-36, 2-37). Gages and transmitters are protected by 1-ampere fuses, placarded FUEL PRESS on the copilot's circuit breaker and fuse panel.

Section IV. FUEL SYSTEM

2-34. Fuel Supply System.

The engine fuel supply system (fig. 2-18) consists of two identical systems sharing a common fuel management panel and fuel crossfeed manifold. Each fuel system consists of four interconnected wing tanks, a nacelle tank, a boost pump located within the nacelle tank, a fuel transfer pump located within the inboard wing tank, a fuel heater (engine oil-to-fuel heat exchanger unit), a tank vent system, a tank vent heating system and interconnecting wiring and plumbing.

a. Boost Pumps.

CAUTION

Engine operation using only the engine-driven fuel pump without boost fuel pressure is limited to 10 cumulative hours. All time in this category shall be entered on DA Form 2408-13 for the attention of maintenance personnel.

A submerged boost pump in each nacelle tank supplies fuel under pressure to an engine-driven high pressure pump on each engine. Engine operation will quickly terminate if the engine-driven high pressure pump fails. However, if a boost pump fails, engine operation can be sustained by the engine-mounted pump alone for a limited time. The boost pumps are protected by two 5-ampere circuit breakers placarded BOOST PUMP located on the fuel system circuit breaker panel (fig. 2-19).

b. Fuel Transfer Pumps. A submerged, electrically-operated fuel transfer pump is located in each inboard wing tank. Fuel level in the nacelle tank is automatically maintained by gravity feed from the wing tanks. However, approximately 28 gallons (182 pounds) in each of the inboard wing tanks will not gravity feed. This fuel is moved by the fuel transfer pumps. These transfer pumps are energized and de-energized by a fuel quantity sensor located in each nacelle tank (when the transfer pump switches are in the ON position). Whenever the nacelle tank quantity drops to 8 gallons (52 pounds), the transfer pump is automatically energized and begins the transfer of fuel from the wing tanks to the nacelle tank. Fuel transfer continues until the fuel quantity in the nacelle tank reaches 24 gallons (156 pounds). The fuel transfer pumps are protected by two 5-ampere circuit breakers placarded FUEL TRANSFER, located on the fuel system circuit breaker panel (fig. 2-19).

c. Fuel Management Panel (fig. 2-19). The fuel management panel is located on the cockpit sidewall, on the left side of the pilot. It contains the fuel gages, boost pump switches, transfer pump switches, transfer test light, crossfeed valve switch, firewall shutoff valve switches, and eight circuit breakers protecting the fuel system.

(1) Boost pump switches. Two switches on the fuel management panel control a submerged pump in corresponding nacelle tanks. Each is a two-position toggle switch of the lever-lock type. At each position, the toggle lever is restrained to prevent accidental change of setting. To reposition

NOTE

- RIGHT SYSTEM IS IDENTICAL TO LEFT EXCEPT THE LATTER CONTAINS THE CROSSFEED VALVE. AND THERE IS A THERMAL RELIEF VALVE AND LINE FROM THE CROSSFEED LINE IN THE RIGHT FUEL SYSTEM.
- TOTAL USABLE FUEL 370 GALLONS.

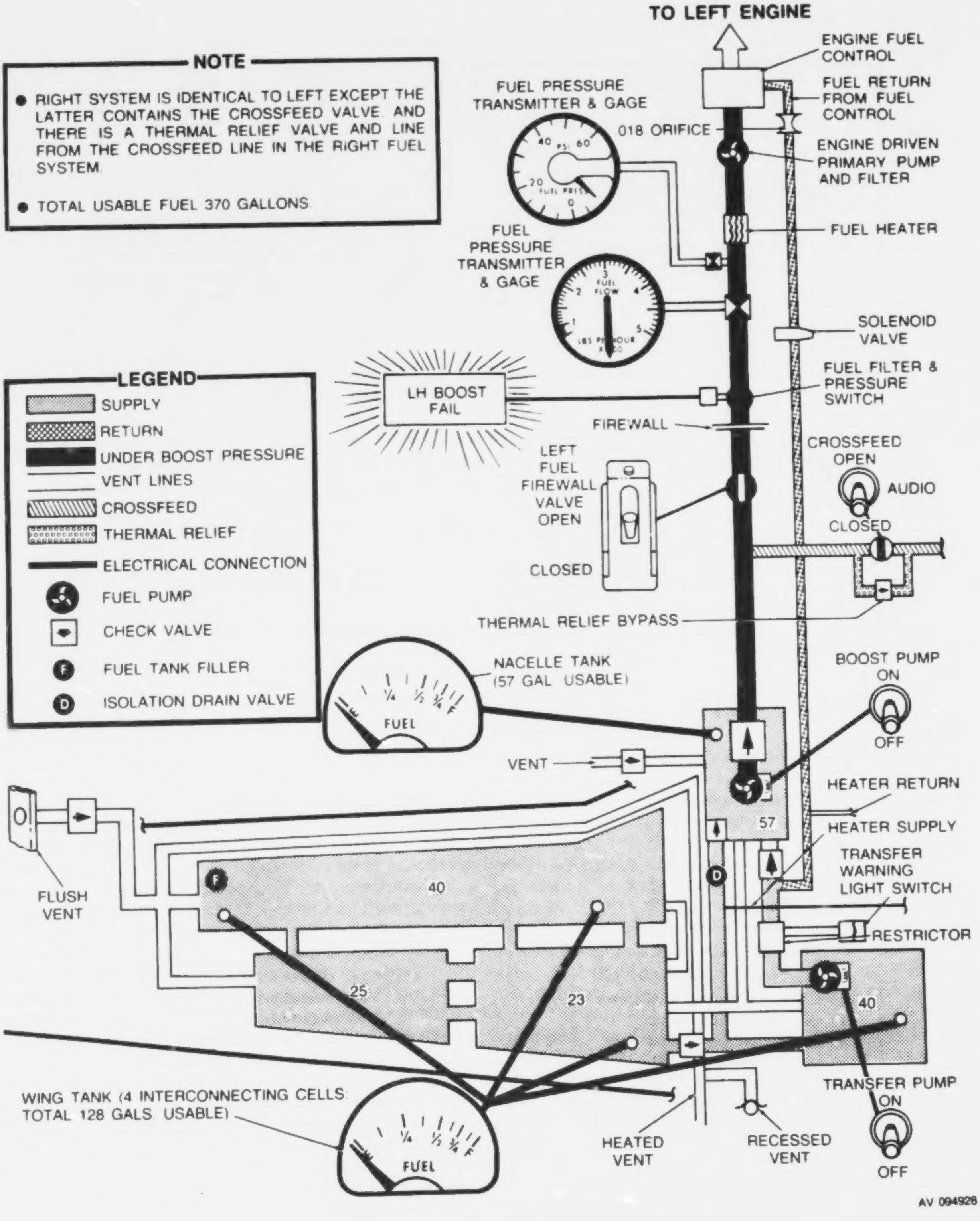
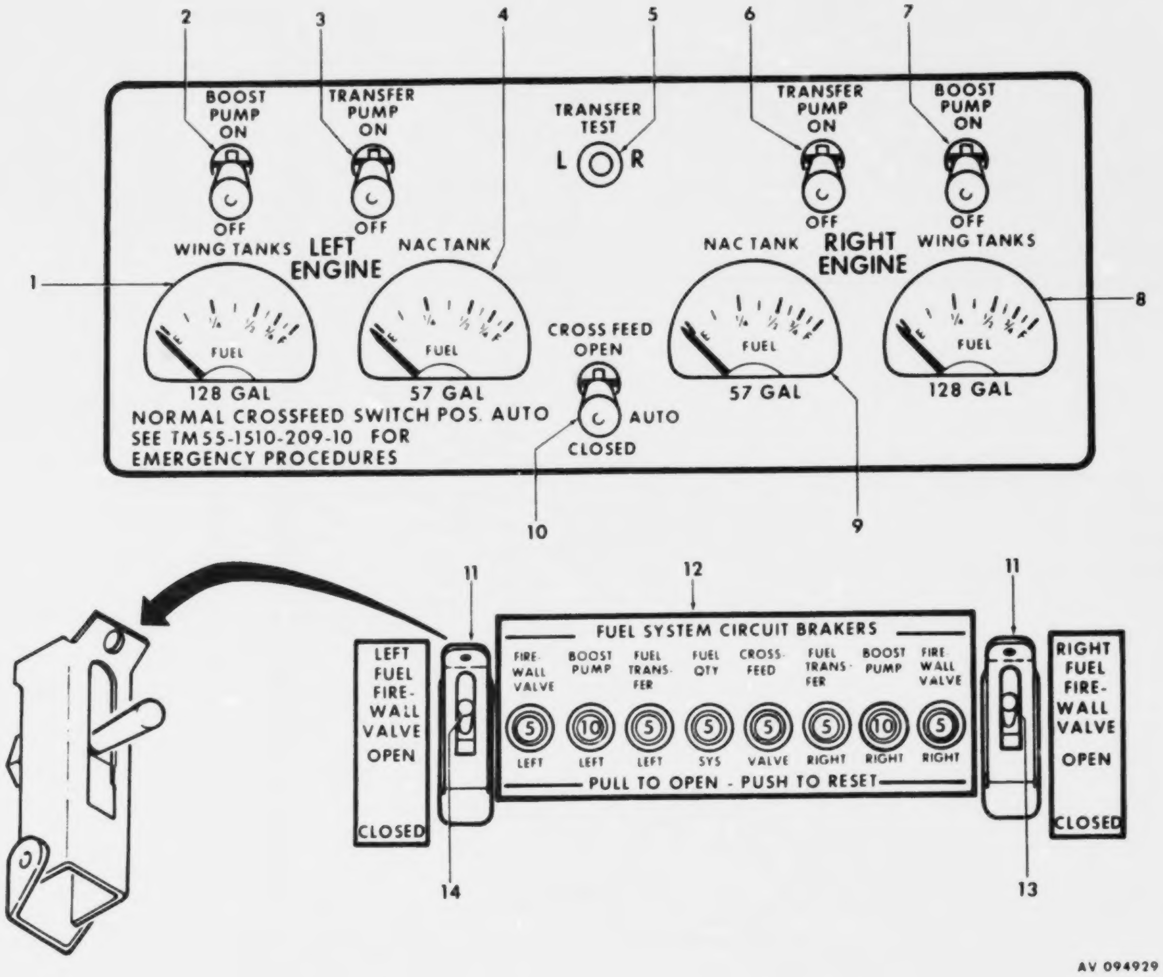


Figure 2-18. Fuel System Schematic



1. Left wing tanks (4) fuel quantity gage
2. Left submerged fuel boost pump switch
3. Left fuel transfer pump switch
4. Left nacelle tank fuel quantity gage
5. Left or right fuel transfer test switch
6. Right fuel transfer pump switch
7. Right submerged fuel boost pump switch
8. Right wing tanks (4) fuel qunatity gage
9. Right nacelle tank fuel quantity gage
10. Fuel crossfeed valve switch
11. Firewall switch cover guard
12. Fuel system circuit breaker panel
13. Right fuel firewall valve switch
14. Left fuel firewall valve switch

Figure 2-19. Fuel Management Panel

the switch, pull the toggle lever outward, move to the new setting, then release. The switches are placarded BOOST PUMP, ON and OFF (fig. 2-19) and are both ON during normal operation of the aircraft. If boosted fuel pressure is not available, a flashing FAULT WARN light starts and a red LH BOOST FAIL or RH BOOST FAIL light illuminates on the annunciator panel.

(2) Fuel transfer pump switches. Two switches on the fuel management panel, placarded TRANSFER PUMP, ON and OFF, control "arming" of the fuel transfer pumps in normal mode, (fig. 2-19). Each is a two-position toggle switch of the lever-lock type. At each position, the toggle lever is restrained to prevent accidental change of setting. To reposition the switch, pull the toggle lever outward, move to the new setting, then release. Transfer pumps transfer fuel from the center wing tanks into the corresponding nacelle tanks. During normal system operation, both switches are ON, which allows transfer pump ON-OFF function to be automatically controlled by a quantity sensor in each nacelle tank so that a proper fuel level is maintained. If either transfer pump fails to operate, when switched ON and triggered to function by it's quantity sensor, the fault condition is indicated to the pilot. Fault indication consists of a flashing red FAULT WARN light and a steady illuminated LH NO FUEL TRANSFER or RH NO FUEL TRANSFER light on the annunciator panel (fig. 2-36, 2-37).

(3) Fuel transfer test switch. A switch, placarded TRANSFER TEST (fig. 2-19) on the fuel management panel, provides a means to check the operation of either fuel transfer system. This switch is a three-position toggle unit spring-loaded to the off (center) position. When positioned to either L (left) or R (right) the switch applies power to the selected transfer pump, bypassing the normal automatic circuit. If the nacelle tank is full, the selected transfer pump will be energized momentarily, which is enough to establish the operating status of that transfer system, indicated by the momentary flash of a yellow caution indicator light, LH NO FUEL TRANSFER or RH NO FUEL TRANSFER.

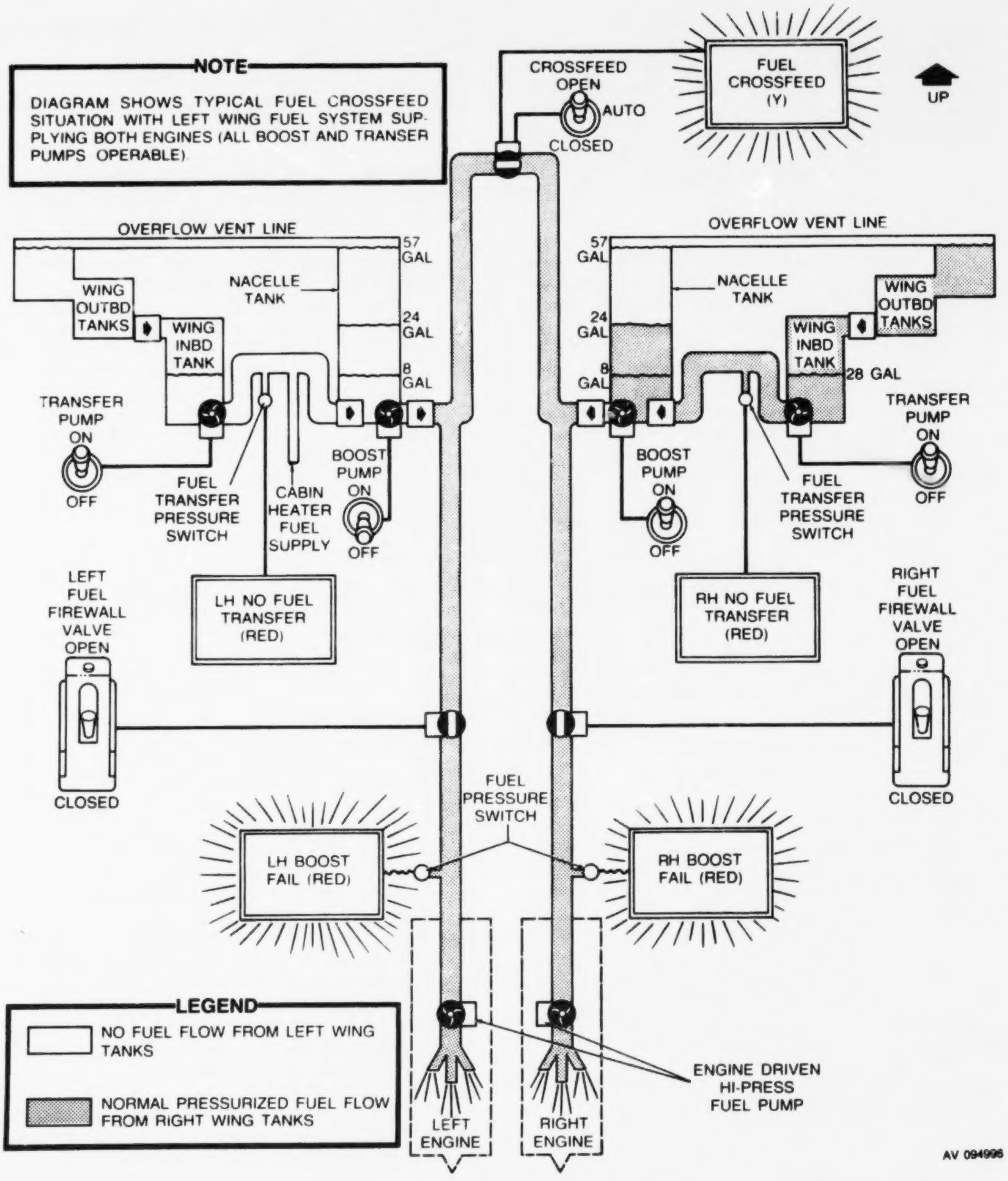
(4) No fuel transfer indicator lights. When all usable fuel has been transferred from a wing tank system, a sensing switch detects pressure drop in the fuel transfer line and after 30 seconds the affected transfer pump is shut off and an indicator light on the annunciator panel illuminates: (LH NO FUEL TRANSFER or RH NO FUEL TRANSFER).

NOTE

The NO FUEL TRANSFER light will also serve as an operational indicator for the designated transfer pump. If the light illuminates, and the respective wing tank gage does not show empty, the transfer pump has stopped transferring fuel into the nacelle tank. A positive transfer pump test without fuel transfer indicates a nacelle tank float switch failure. Holding the TRANSFER TEST switch ON will override the float switches and allow transfer of the remaining fuel. The NO FUEL TRANSFER light may be extinguished by turning the transfer pump OFF.

(5) Fuel crossfeed switch. The fuel crossfeed system (fig. 2-20) is controlled by a three-position switch (fig. 2-19), located on the fuel management panel, placarded OPEN, CLOSED, and AUTO. Using this switch, the crossfeed valve may be manually opened or closed. This is a three-position toggle switch of the lever-lock type. At each position, the toggle lever is restrained to prevent accidental change of setting. To reposition the switch, pull the toggle lever outward, move to the new setting, then release. Under normal flight conditions the switch is left in AUTO position, which will automatically open the crossfeed valve if a drop in line pressure occurs. This feature allows the remaining boost pump to supply both engines with fuel under pressure. Crossfeed valve operation is indicated by the illumination of a yellow light (FUEL CROSSFEED). When the switch is placed in OPEN position, the crossfeed valve is opened and will allow fuel to transfer, so that fuel in either system may supply both engines. Fuel is not crossfed from the tanks of one system into the tanks of the opposite system, but rather is pumped directly into the fuel supply line at the opposite engine at a point ahead of the line check valve. With the switch in the CLOSED position, the two halves of the fuel system are separated, preventing crossfeed between systems.

(6) Fuel crossfeed indicator light. Illumination of the yellow FUEL CROSSFEED light, indicates that the electrically operated crossfeed valve is open.



NOTE

DIAGRAM SHOWS TYPICAL FUEL CROSSFEED SITUATION WITH LEFT WING FUEL SYSTEM SUPPLYING BOTH ENGINES (ALL BOOST AND TRANSER PUMPS OPERABLE).

LEGEND

☐ NO FUEL FLOW FROM LEFT WING TANKS

▨ NORMAL PRESSURIZED FUEL FLOW FROM RIGHT WING TANKS

Figure 2-20. Crossfeed Fuel Flow

Table 2-2. Fuel Quantity Data

	TANKS	NUMBER	USABLE FUEL	**WEIGHT/POUNDS
LEFT ENGINE	Wing tanks	4	128	832.0
	Nacelle tank	1	57	370.5
RIGHT ENGINE	Wing tanks	4	128	832.0
	Nacelle tank	1	57	370.5
	*Totals	10	370	2405.0

* Unusable fuel quantity and weight (3.6 gallons, 24 pounds not included in totals).

** Fuel weight is based on standard day conditions at 6.5 pounds per U.S. gallon. Total fuel system capacity is 373.6 gallons.

NOTE

The FUEL CROSSFEED light may remain illuminated if the crossfeed valve closes in case of malfunction. The same circuit that opens the crossfeed valve, also illuminates the FUEL CROSSFEED light.

(7) *Fuel quantity indicators.* Four fuel quantity gages are mounted on the fuel management panel (fig. 2-19). All gages are calibrated in quarters of total tank capacity. Two gages indicate total quantity of each fuel system: one gage indicating fuel quantity of the nacelle tank and the other indicating fuel quantity of the four interconnected wing tanks. Fuel quantity data is supplied by table 2-2.

(8) *Firewall shutoff valves.*

CAUTION

Do not use the fuel firewall shut-off valve to shut down an engine, except in an emergency. The engine-driven high-pressure fuel pump obtains essential lubrication from fuel flow. When an engine is operating, this pump may be severely damaged (while cavitating) if the firewall valve is closed before the condition lever is moved to the FUEL CUTOFF position.

Two guarded switches, placarded LEFT FUEL FIREWALL VALVE and RIGHT FUEL FIREWALL VALVE, on the fuel management panel, are provided to give the pilot electrical fuel shut-off capability at each engine firewall (fig. 2-19). Each switch is a two-position unit controlling the corresponding firewall shut-off valve. OPEN position, opens the firewall shut-off valve admitting fuel to the engine. In the CLOSED position, fuel flow to the affected engine is completely cut off, thereby isolating that engine's fuel supply, although the isolated fuel may be supplied to the opposite engine by crossfeed. A hinged, red colored, metal guard (fig. 2-19) engages each firewall valve switch toggle when the switch is in the OPEN position. This guard prevents inadvertent movement of the switch to the CLOSED position. The guard must be manually disengaged from the switch toggle to move the switch to the CLOSED position.

d. *Fuel Tank Sump Drains.* Fuel system tanks and interconnect lines may be drained of moisture condensate and sediment by means of 10 drains (plus two for the ferry system, when installed), located at the system low points on the nacelle tanks, wing tanks, and at the fuel filter drain at the inertial separator air bypass duct.

e. *Fuel Vent System.* Three fuel vents are located under each wing. One serves both the nacelle and wing tanks, and is protected against icing conditions by an electric heating element. (Refer to Section VII, UTILITY SYSTEMS for fuel system anti-icing information.)

f. *Thermal Pressure Relief Valve.* Volume expansion in the fuel system is relieved by a thermal pressure relief valve. Normally, thermal expansion occurs only during hot weather while the aircraft is static on the ground.

g. Engine Oil-to-Fuel Heat Exchanger. An engine oil-to-fuel heat exchanger, located on each engine accessory case, operates continuously and automatically to heat the fuel delivered to the engine sufficiently to prevent the freezing of any water which it might contain. The temperature of the delivered fuel is thermostatically regulated to remain between +21°C and +32°C.

2-35. Fuel Management.

CAUTION

> During normal fuel system operation all usable fuel of each system can be used. However, if a transfer pump becomes inoperative, approximately 28 gallons of wing fuel from the respective system cannot be used because gravity feed will stop with approximately 28 gallons of fuel remaining within the respective wing tanks (fig. 2-21).

Fuel used from the nacelle tanks is replenished by gravity feed alone, until the level within the tank is depleted to 8 gallons (52 pounds). (fig. 2-21.) At the 8 gallon (52 pounds) level, the low switch position on the level sensor float is actuated which causes fuel transfer to start. When the fuel quantity rises to 24 gallons (156 pounds), transfer action is cutoff by the second switch position on the float. Unless the pilot uses manual transfer control after the first transfer cycle, all subsequent fuel transfer will maintain quantity within the nacelle tanks at a level between 8-24 gallons (52-156 pounds), until all fuel is used from the wing tanks.

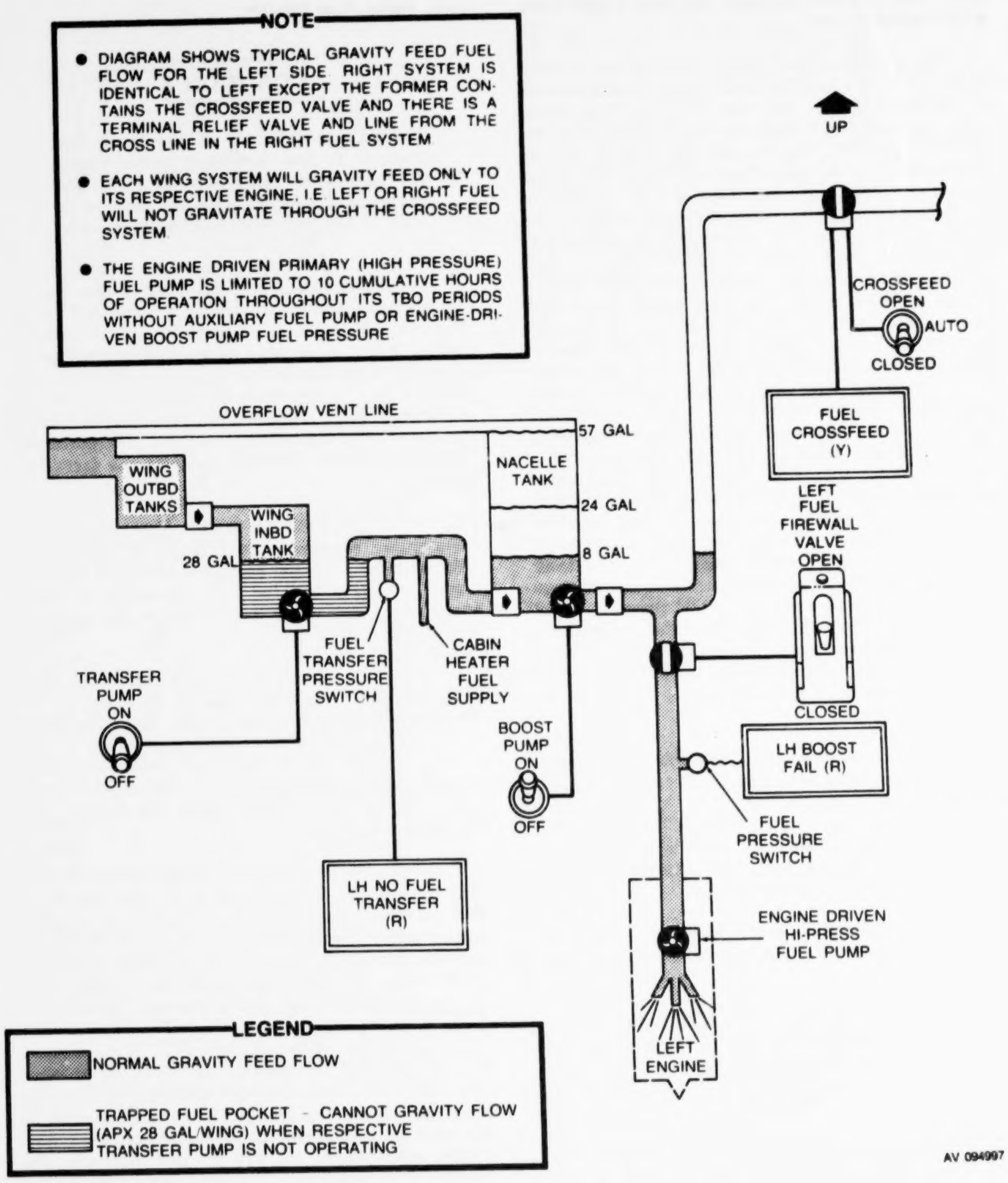
(1) Transfer pump manual operation. While sufficient fuel remains in the wing tanks, the pilot may use manual control to refill the nacelle tanks to capacity. Refilling must be conducted with the TRANSFER PUMP switch on, and by simultaneously placing the TRANSFER TEST switch at L or R position (whichever applies). If the TRANSFER TEST switch is held at the L or R setting momentarily, then released, the initiated fuel transfer will be shutoff by either the 24 or 57 gallon (156 or 370.5 pound) float switch position, whichever the rising fuel level encounters first. If the TRANSFER TEST switch is manually retained in the ON position fuel transfer will continue until the switch is released. In this instance, the transfer pump shutoff circuits on the 24 and 57 gallon (156 and 370.5 pound) float switches are bypassed, and if enough fuel is present in the wing tanks, the nacelle tank may be overfilled – resulting in excess fuel flowing through the vent lines back into the wing tanks. A safe continuous-transfer loop is thus established, but is not a recommended procedure. Unless a nacelle tank is full to capacity whenever a TRANSFER PUMP switch is turned ON, after an OFF period, the affected pump will start an immediate transfer cycle. Transfer will continue until fuel within the receiving tank rises enough to actuate a float-switching position which was not already exceeded by the fuel level when the TRANSFER PUMP switch was placed ON. If fuel quantity before the start of transfer was between 8-24 gallons (52-156 pounds), transfer power will be cut off at the 24 gallon (156 pound) float-switching level. However, if quantity within a nacelle tank is above the 24 gallon (156 pound) switching level, when the TRANSFER PUMP switch is turned ON, a transfer will initiate – continuing to fill the tank until the top float-switching position of 57 gallons (370.5 pounds) is reached.

(2) Top nacelle fuel quantity sensor failure (continuously full nacelle tank). If fuel transfer into a nacelle tank should not be terminated by actuation of the top level float switch, over-fill fuel will flow back into wing tanks through vent lines. Operation would stabilize into a continuous fuel transfer loop. A continuously full nacelle tank, monitored on the gage, would indicate this condition and can be corrected by using the following procedure:

1. Reset the appropriate TRANSFER PUMP switch to OFF.

2. When the gage of the affected tank indicates a quantity below 24 gallons (156 pounds), reset the TRANSFER PUMP switch to ON. This will reset the automatic level control between the limits of 8-24 gallons (52-156 pounds).

(3) When engines are running, transfer pump operation must be checked by a method which does not depend on sound. Another factor is that transfer may be already underway when the pilot decides to conduct the transfer check. He cannot hear pumps running, and if transfer is in progress, the associated NO FUEL TRANSFER annunciator light will not flash, due to pressure within the transfer line. For fuel transfer pump operational check procedure, refer to chapter 8.



NOTE

- DIAGRAM SHOWS TYPICAL GRAVITY FEED FUEL FLOW FOR THE LEFT SIDE. RIGHT SYSTEM IS IDENTICAL TO LEFT EXCEPT THE FORMER CONTAINS THE CROSSFEED VALVE AND THERE IS A TERMINAL RELIEF VALVE AND LINE FROM THE CROSS LINE IN THE RIGHT FUEL SYSTEM.
- EACH WING SYSTEM WILL GRAVITY FEED ONLY TO ITS RESPECTIVE ENGINE, I.E. LEFT OR RIGHT FUEL WILL NOT GRAVITATE THROUGH THE CROSSFEED SYSTEM.
- THE ENGINE DRIVEN PRIMARY (HIGH PRESSURE) FUEL PUMP IS LIMITED TO 10 CUMULATIVE HOURS OF OPERATION THROUGHOUT ITS TBO PERIODS WITHOUT AUXILIARY FUEL PUMP OR ENGINE-DRIVEN BOOST PUMP FUEL PRESSURE.

Figure 2-21. Gravity Feed Fuel Flow

2-36. Fuel System Features Affecting Flight Time After Heater Cutoff.

The aircraft has a check valve in the gravity feed line to the nacelle tank which is downstream of the cabin heater tap into the line. This check valve isolates fuel within the nacelle tank from the cabin heater (i.e., fuel in the left nacelle tank is unavailable to the cabin heater). When fuel level within the left wing tanks falls to a level with the main gravity feed interconnect line between the outboard wing and the center section tanks, the cabin heater will cease to operate due to fuel starvation. At this point, approximately 28 gallons of fuel remain in the left wing tanks. Since fuel level in the wing tanks will lag behind the fuel level in the corresponding nacelle tanks, due to opposing head pressure and line losses, the actual level within the wing tanks is indeterminate at the time when the transfer pump starts to transfer fuel. However, float switches maintain fuel level within the left nacelle tank between two limits during transfer operation. These limits represent a maximum or minimum fuel level within the left nacelle tank between two limits during transfer operation. These limits represent a maximum or minimum fuel level which the left nacelle tank could hold at the time when fuel starvation stops the cabin heater. Actual "on hand" reserve of fuel is not computable, but would likely fall somewhere between these quantity limits at heater cutoff. Distribution of on board fuel for the maximum and minimum reserve limits at heater cutoff is as follows:

(1) During normal operation, maximum fuel on board when cabin heater stops - (per engine).

24 gallons - - nacelle tank
28 gallons - - wing tanks
52 gallons - - Total

(2) During normal operation, minimum fuel on board when cabin heater stops - (per engine).

8 gallons - - nacelle tank
28 gallons - - wing tanks
36 gallons - - Total

NOTE

Information pertaining to available flight time after cabin heater cutoff is based on the condition that initial fuel quantity in the left wing tanks, external to the nacelle tank, must exceed 28 gallons.

2-37. Ferry Fuel System.

CAUTION

Do not use AVGAS in the ferry fuel system. It has not been tested using AVGAS. Flow rates will be less, and consequently ferry fuel pump may not be able to keep up with engine demand.

a. Description. The ferry fuel system (fig. 2-22) provides additional fuel for extended range missions. The system consists of two removable fuel tanks, a removable ferry fuel control panel assembly, a permanently installed vent system and permanently installed interconnecting plumbing and wiring. A 15-ampere circuit breaker located on the lower wall behind the copilot's seat placarded FERRY SYSTEM POWER protects the ferry fuel system.

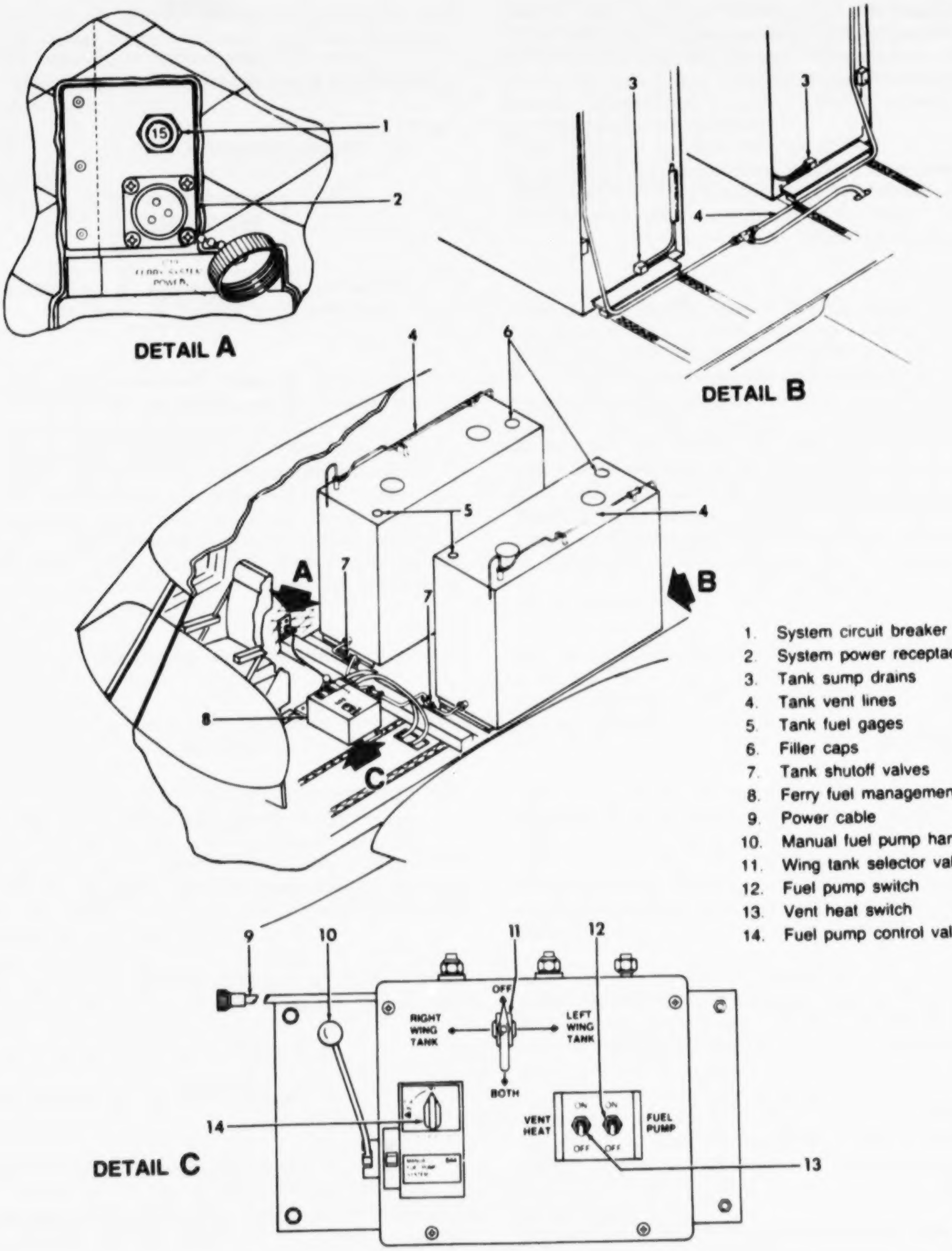
(1) Ferry fuel tanks. Two removable rectangular aluminum fuel tanks of 120 gallons (780 pounds) capacity each are bolted to the seat tracks in the cabin for ferry missions. A water sump and drain valve is provided at the lower aft end of each tank.

(a) Ferry tank fuel gages. One float actuated dial type fuel gage is provided on the forward end of the top side of each ferry fuel tank.

(b) Ferry fuel tank shutoff valves. A shutoff valve is located on the fuel line between each ferry fuel tank and the ferry fuel management panel.

(2) Ferry fuel control panel assembly. This unit is removed from the aircraft when the ferry fuel system is not required. It mounts to the seat tracks across the aisle directly aft of the pilot's and copilot's seats. It consists of two fuel switching valves, two circuit-breaker switches, a fuel filter, an electric fuel pump, and a manual fuel pump.

(a) Manual fuel pump. If the electric fuel pump fails to operate, fuel may be pumped from the ferry fuel system tanks into the wing tanks by means of a manual fuel pump, located on the copilot's side of the fuel control panel assembly. When operated at 34 strokes per minute, the manual fuel pump will transfer 48 gallon/hour (315 pounds/hour) of fuel to the left wing and 48 gallon/hour (315 pounds/hour) of fuel to the right wing simultaneously (a total of 97 gallons/hour (630 pounds)). The manual fuel pump will transfer



1. System circuit breaker
2. System power receptacle
3. Tank sump drains
4. Tank vent lines
5. Tank fuel gages
6. Filler caps
7. Tank shutoff valves
8. Ferry fuel management panel
9. Power cable
10. Manual fuel pump handle
11. Wing tank selector valve
12. Fuel pump switch
13. Vent heat switch
14. Fuel pump control valve

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Figure 2-22. Ferry Fuel System

80 gallons/hour (520 pounds/hour) of fuel to one wing only. To maintain an equal fuel flow with engine consumption set at 200 pounds/hour, 22 strokes/minute are required.

(b) Ferry fuel selector valve. A four-position valve located on the ferry fuel control panel, placarded OFF, LEFT WING TANK, BOTH, RIGHT WING TANK, controls the flow of fuel from the ferry tanks.

(c) Electric fuel pump and switch. Fuel is normally pumped from the ferry tanks by an electric fuel pump, located in the ferry system control panel assembly. It is controlled by a 7.5 ampere circuit-breaker switch, located on the ferry system fuel control panel, placarded FUEL PUMP, OFF, ON. The electric fuel pump will transfer 46 gallons/hour (300 pounds/hour) of fuel to the left wing and 46 gallons/hour (300 pounds/hour) of fuel to the right wing simultaneously (a total of 92 gallons (600 pounds/hour)). The electric fuel pump will transfer 77 gallons/hour (500 pounds/hour) of fuel to one wing only.

(d) Ferry system fuel vent heater switch. The ferry system fuel vent heater is controlled by a 7.5-ampere circuit-breaker switch located on the ferry system fuel control panel, placarded VENT HEAT, OFF, ON.

(e) Manual fuel pump control valve. A two position valve located on the ferry fuel control panel placarded FUEL SELECTOR - OFF, ON controls the flow of fuel through the ferry fuel system. Fuel cannot be pumped into the wing tanks by either the electric or manual pump unless this valve is in the ON position.

(f) Ferry system fuel filter. Fuel from the ferry tanks is pumped through a fuel filter, located on the copilot side of the fuel system control panel assembly, placarded FUEL FILTER.

(3) Ferry fuel tank vent system. The ferry fuel tanks are connected to a heated fuel vent located on the underside of the aft fuselage. Secondary tank vents are installed on the top of each tank.

(4) Ferry system wheel well fuel shutoff valves. A fuel shutoff valve is installed on the ferry system fuel line in the forward section of each main wheel well. These valves must be open and secured with safety wire when the ferry system is being used.

NOTE

A safety of flight release is required for takeoff above maximum takeoff weight.

b. Normal Operation.

WARNING

Smoking in the aircraft is prohibited when the ferry system is installed.

WARNING

Continuing to pump fuel from the ferry tanks into the wing tanks after they are full will result in fuel being dumped overboard through the wing fuel tank vent system.

(1) Preflight functional test.

NOTE

The aircraft's wing tanks should be nearly empty before beginning the ferry system preflight functional test. This will provide tank space for fuel transferred from the ferry tanks.

1. Ferry fuel tank shutoff valves (two, located between ferry tank outlet and ferry fuel control panel) – On.
2. Ferry fuel selector valve – OFF.
3. Manual fuel pump control valve – OFF.
4. Heated fuel vent switch – OFF.
5. Ferry system electric fuel pump switch – OFF.
6. Wing fuel drains – Closed.
7. Ferry tank water sumps (two) – Closed.

8. Ferry system wheel-well fuel shutoff valves (two) – Check open and safetied.

9. Aircraft electrical equipment switches (all) – Off.

10. GPU – Connect.

11. Battery switch – ON.

WARNING

The battery switch may be left on to monitor fuel quantity gages and ferry fuel system electric pump, but must not be moved during fueling operations.

12. Ferry fuel tanks – Fill in accordance with fuel handling precautions and servicing instructions in Section XII, Servicing, Parking and Mooring.

13. Ferry system fuel lines and connectors – Check for leaks.

14. Left ferry fuel tank shutoff valve – Off.

15. Right wing tank fuel gage – Note indicated fuel quantity.

16. Right ferry tank fuel gage – Note indicated fuel level. Remove right ferry tank filler cap and visually check that indicated fuel quantity corresponds to gage indication.

17. Manual fuel pump control valve – FUEL ON.

NOTE

The manual fuel pump control valve must be in the FUEL ON position to transfer fuel whether using the manual or electric fuel pump.

18. Ferry fuel selector valve – RIGHT WING TANK.

19. Ferry system electric fuel pump – ON. Transfer approximately 30 gallons of fuel (roughly one quarter of right ferry tank capacity) from the right ferry tank to the right wing tank system. Transfer of 30 gallons of fuel should take approximately 40 minutes.

20. Right ferry system fuel lines and connectors – Check for leaks while fuel is flowing.

21. Ferry system electric fuel pump – OFF.

22. Ferry fuel selector valve – OFF.

23. Right wing tank fuel gage – Check for increased indicated fuel quantity of approximately one quarter tank.

24. Right ferry tank fuel gage – Note indicated fuel level. Remove right ferry tank filler cap and visually check that gage reading approximately corresponds with quantity of fuel that has actually been transferred.

25. Right ferry fuel tank shutoff valve – Off.

26. Left ferry fuel tank shutoff valve – On.

27. Ferry fuel selector valve – LEFT WING TANK.

28. Left wing tank fuel gage – Note indicated fuel quantity.

29. Left ferry tank fuel gage – Note indicated fuel level. Remove left ferry tank filler cap and visually check that indicated fuel quantity corresponds to gage indication.

30. Ferry system electric fuel pump switch – ON. Transfer approximately 30 gallons of fuel (approximately one quarter of left ferry tank capacity) from the left ferry tank to the left wing tank system. Transfer of 30 gallons of fuel should take approximately 40 minutes.

31. Left ferry fuel system fuel lines and connectors – Check for leaks while fuel is flowing.

32. Ferry system electric fuel pump switch – OFF.

33. Left wing tank fuel gage – Check for increased indicated fuel quantity of approximately one quarter tank.

34. Left ferry tank fuel gage – Note indicated fuel level. Remove left ferry tank filler cap and visually check that indicated fuel quantity corresponds to gage indication.

35. Manual fuel pump – Operate at approximately 34 strokes per minute. Transfer approximately 10 gallons of fuel in to left wing tank system. Visually check fuel level inside left ferry tank before and after manual fuel pump check to insure that fuel actually has been transferred.

36. Wing tank fuel gages (2) – Note indicated fuel quantity.

37. Ferry tank fuel gages (2) – Note indicated fuel quantity.

38. Right ferry fuel tank shutoff valve – ON.

39. Ferry fuel selector valve – BOTH.

40. Ferry system electric fuel pump – ON. Transfer approximately 60 gallons of fuel (approximately one quarter of the capacity of both ferry tanks). Transfer of 60 gallons of fuel should take approximately 40 minutes.

41. Ferry system electric fuel pump – OFF.

42. Ferry fuel selector valve – OFF.

43. Ferry fuel tank shutoff valves (2) – On.

44. Manual fuel pump control valve – OFF.

45. Ferry fuel system vent heat switch – ON. Check that temperature of heated vent increases then turn switch OFF.

46. Battery switch – OFF.

47. GPU – Disconnect as required.

48. Ferry fuel tanks – Fill in accordance with fuel handling precautions and servicing instructions in Section XII, Servicing, Parking and Mooring.

NOTE

Settling time for jet fuels is one hour per foot of tank depth. Allow the fuel to settle for the prescribed period of time before any fuel samples are taken.

49. Fuel sample – Take from each ferry tank drain.

50. Ferry fuel tank fuel and caps – Check fuel level visually. Check seal is installed, cap is tight and properly installed.

(2) Before takeoff. Heated fuel vent switch – ON.

(3) During flight.

1. Wing fuel gages – Monitor (until wing tanks are ½ to ¾ full).

2. Ferry system fuel selector valve – LEFT WING TANK, BOTH or RIGHT WING TANK as required.

3. Manual fuel pump selector valve – ON.

4. Ferry system electric fuel pump switch – ON.

5. Wing fuel gages – Monitor (until wing tanks are almost full).

6. Ferry system electric fuel pump switch – OFF.

7. Manual fuel pump selector valve – OFF.

8. Steps 1-7 – Repeat as required until ferry fuel tanks are empty.

c. *Emergency Operation.* If the ferry system electric fuel pump should fail to operate, follow the procedure outlined below.

1. Ferry system fuel selector valve – LEFT WING TANK, BOTH, or RIGHT WING TANK as required.

2. Manual fuel pump selector valve – ON.

3. Manual fuel pump handle – Pump as required.

NOTE

Fuel will not gravity feed from the ferry tanks to the wing tanks.

2-38. Approved Fuels.

CAUTION

The use of aviation gasoline is time-limited to 150 hours of operation during any Time-Between-Overhaul (TBO) period. It may be in any quantity with aviation kerosene.

CAUTION

Do not use AVGAS in the ferry fuel system. It has not been tested using AVGAS. Flow rates will be less, and consequently ferry fuel pump may not keep up with engine demand.

The aircraft may use JP-4 or JP-5 in any ratio. Civilian jet fuel may not contain an anti-ice/fungicide and may thicken when temperatures drop below −40°F. In the event aviation kerosene is not available, aviation gasoline is an approved emergency fuel. Refer to Section XII.

NOTE

Aviation gasoline (AVGAS) contains a form of lead which has an accumulative adverse effect on gas turbine engines. The lowest octane AVGAS available (less lead content) shall be used. If more than 10% of the total fuel on board is AVGAS, the total operating time shall be entered in DA Form 2408-13.

Section V. FLIGHT CONTROLS

2-39. Description.

The aircraft's primary flight control system consists of rudder, elevator and aileron control surfaces. These surfaces are manually operated from the cockpit through mechanical linkage using control wheels for the ailerons and elevators, and adjustable rudder/brake pedals for the rudder. Trim control for the rudder, elevator and ailerons is accomplished through a manually actuated cable-drum system for each set of control surfaces.

2-40. Control Wheels. RU-21A

Elevator and aileron control surfaces are operated by actuating either the pilot's or copilot's control wheel (fig. 2-23). A microphone switch and a chaff dispense switch are incorporated in each control wheel. The pilot's control wheel also has an autopilot disconnect switch and an 8 day manually wound clock.

2-41. Control Wheels. RU-21D

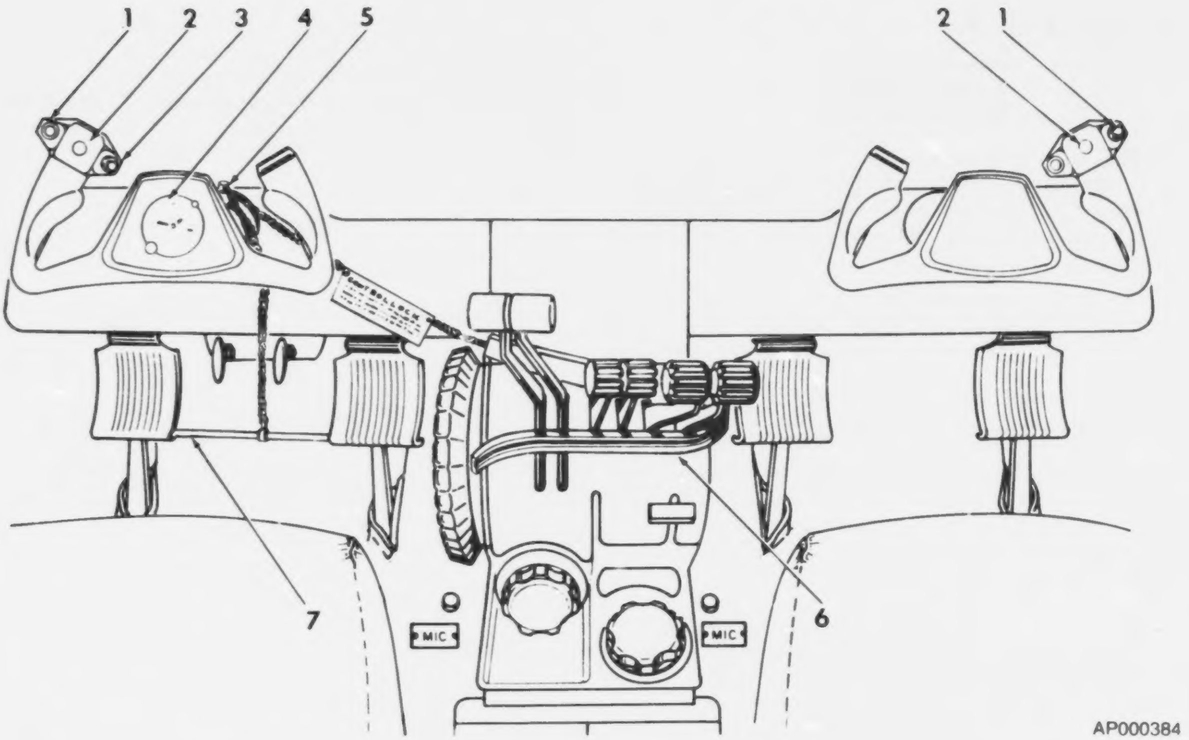
Elevator and aileron control surfaces are operated by manually actuating either the pilot's or copilot's control wheel (fig. 2-24). A microphone switch is incorporated in each control wheel.

2-42. Rudder Pedals.

Aircraft rudder control and nose wheel steering is accomplished by actuation of the rudder pedals from either pilot's or copilot's station (fig. 2-9, 2-10). A fore and aft position adjustment of the pedals is provided through an adjustment control lever on each pedal. For toe brake coverage refer to Wheel Brake System (para. 2-8).

2-43. Flight Controls Lock.

Positive locking of the rudder, elevator and aileron control surfaces, and engine controls (power levers, propeller levers, and condition levers) is provided by a removable lock assembly consisting of two pins and an elongated U-shaped strap interconnected by a chain (fig. 2-23, 2-24). Installation of the control locks is accomplished by inserting the strap over the aligned engine control levers from the copilot's side; then the aileron-elevator locking pin is inserted through a guide hole in the top of the pilot's control column assembly, thus locking the control wheels. The rudder pedals are held in the neutral position by the largest of the two pins, which is installed horizontally through the pilot's rudder pedals. Removal sequence is a reverse of the installation procedure.



1. Chaff dispense switch
2. Microphone switch
3. Autopilot disengage switch
4. Clock
5. Aileron-elevator lock pin
6. Engine controls lock bar
7. Rudder lock pin

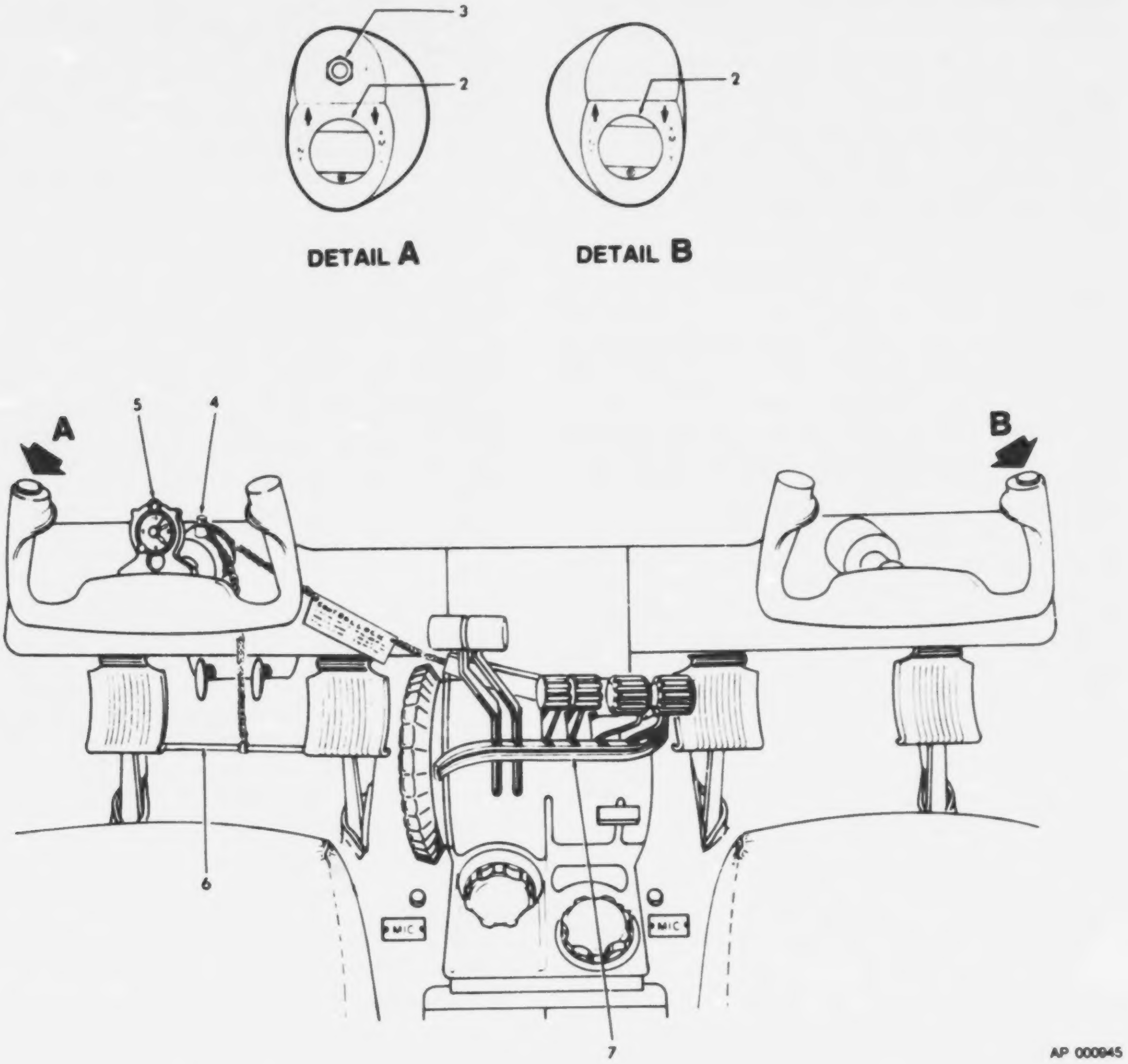
Figure 2-23. Control Wheels and Control Locks RU-21A

2-44. Trim Tabs.

Trim tabs are provided for all flight control surfaces. These tabs are manually actuated, and are mechanically controlled by a cable-drum and jack-screw actuator system. Elevator and aileron trim tabs incorporate anti-servo action, i.e., as the elevators or ailerons are displaced from the neutral position, the trim tab moves in the same direction as the applied control surface, thus increasing the effective control surface area and the manual force required to apply it. This action increases control pressure. The rudder trim tab is adjustable left or right as required and maintains an "as adjusted" position throughout the full range of rudder deflection.

a. Elevator Trim Tab Control. The elevator trim tab control wheel placarded ELEVATOR TAB - DOWN, UP, is on the left side of the control 1pedestal and controls a trim tab on each elevator (fig. 2-11, 2-12). The amount of elevator tab deflection, in degrees from a neutral setting, is indicated by a position arrow.

b. Aileron Trim Tab Control. The aileron trim tab control, placarded AILERON TAB - LEFT, RIGHT, is on the control pedestal and will adjust the left aileron trim tab only (fig. 2-11, 2-12). The amount of aileron tab deflection, from a neutral setting, as indicated by a position arrow, is relative only and is not in degrees. Full travel of the tab



1. Identification/position switch
2. Microphone switches
3. Clock
4. Aileron - elevator lock pin
5. Engine controls lock bar
6. Rudder lock pin

Figure 2-24. Control Wheels and Control Locks RU-21D

control moves the trim tab 7-1/2 degrees up and down.

c. Rudder Trim Tab Control. The rudder trim tab control knob, placarded RUDDER TAB - LEFT, RIGHT, is on the control pedestal, and controls adjustment of the rudder trim tab (fig. 2-11, 2-12). The amount of rudder tab deflection, in degrees from a neutral setting, is indicated by a position arrow.

2-45. Wing Flaps.

The all-metal slot-type wing flaps are electrically operated and consist of two sections for each wing. These sections extend from the inboard end of each aileron to the junction of the wing and fuselage. During extension, or retraction, the flaps are operated as a single unit, each section being actuated by a separate jackscrew actuator. The actuators are driven through flexible shafts by a single, reversible electric motor. Wing flap movement, either up or down, is indicated in percent of travel by a flap position indicator on the center of the control pedestal. Full flap extension or retraction time is approximately 11.0 seconds. The flap control switch is also located on the control pedestal. No emergency wing flap actuation system is provided. The circuit is protected by a 20-ampere push-pull circuit breaker, placarded FLAP MOTOR POWER, located on the copilot's circuit breaker and fuse panel (fig. 2-29, 2-30).

a. Wing Flap Control Switch. Flap operation is controlled by a three-position switch with a flap-shaped handle on the control pedestal (fig. 2-11, 2-12). The handle of this switch is placarded FLAP and switch positions are placarded: FLAP - UP, APPROACH, and DOWN. The amount of downward extension of the flaps is established by position of the flap switch, and is as follows: UP – 0%, APPROACH – 35%, and DOWN – 100%. Limit switches, mounted on the right inboard flap, control flap travel. The flap control switch, limit switch, and relay circuits are protected by a 5-ampere circuit breaker, placarded FLAP IND, located on the right subpanel (fig. 2-13, 2-14). Flap positions between UP and APPROACH cannot be selected. For intermediate flap positions between APPROACH and DOWN, the APPROACH position acts as an off position. To return the flaps to any position between full DOWN and APPROACH, place the flap switch to UP and when desired flap position is obtained, return the switch to the APPROACH detent.

b. Wing Flap Position Indicator. Flap position in percent of travel from "0" percent (UP) to 100 percent (DOWN), is shown on an indicator, placarded FLAPS on the control pedestal (fig. 2-11, 2-12). The APPROACH and full DOWN or extended flap position is 15 and 43 degrees, respectively. The flap position indicator is protected by a 5-ampere circuit breaker, placarded FLAP IND, located on the right subpanel (fig. 2-13, 2-14).

Section VI. PROPELLERS

2-46. Description.

A three-bladed aluminum propeller is installed on each engine. These propellers are hydraulically controlled, constant-speed full-feathering and reversible. Each propeller is controlled by engine oil acting through an engine-driven propeller governor. Feathering is accomplished by the feathering springs assisted by centrifugal force applied to the blade shank counterweights. Governor boosted engine oil pressure moves the propeller blades to the high RPM (low pitch) hydraulic stop and into reverse pitch. Low pitch propeller position is determined by a mechanically monitored hydraulic stop. A back-up system, referred to as the secondary low pitch stop, protects against propeller reversing in the event of failure of the primary hydraulic low pitch stop system. In the event of loss of oil pressure, the propeller blades will go to the feathered position.

2-47. Feathering Provisions.

The aircraft is equipped with both manual and automatic propeller feathering. Manual feathering is accomplished by pulling the corresponding propeller lever aft past a friction detent. To unfeather, the propeller lever is pushed forward into the governing range. An automatic feathering system, if armed, will sense loss of torque oil pressure and will feather an unpowered propeller.

a. Automatic Feathering. Automatic feathering can occur only when the PROP AUTOFEATHER switch is in the ARM position, both power levers are above 90% N_1, and the torque value of one engine drops below 160 to 290 ft-lbs. The autofeather system has a cross-interlocking safety feature designed into the control circuit to prevent automatic feathering of both propellers. Before a propeller feathers automatically, the interlock disarms the autofeather circuit of the opposite propeller. After autofeathering has occurred for one propeller the opposite propeller can be feathered only by the manual control. Feathering springs will feather the propeller when it is not turning.

b. Propeller Autofeather Switch. Autofeathering is controlled by a PROP AUTO FEATHER switch on the left subpanel (fig. 2-13, 2-14). The three-position switch is placarded ARM, OFF and TEST, and is spring-loaded from TEST to OFF. The ARM position is used only during takeoff and landing. At ARM, if an engine loses power above 88% to 92%) N_1, two torque-sensing switches of the affected engine are actuated by loss of torque pressure. Switch actuation applies current through an autofeather relay to a corresponding dump valve, causing the release of oil pressure which held an established pitch angle on the blades of the affected propeller. Following the release of oil pressure, feathering movement is accomplished by the feathering springs assisted by centrifugal force applied to the blade shank counterweights. The TEST position of the switch, enables the pilot to check readiness of the autofeather systems, below 90% N_1, and is for ground checkout purposes only. Refer to chapter 8.

c. Autofeather Lights. Two amber lights on the instrument panel, placarded AUTOFEATHER LEFT and RIGHT, when illuminated indicate that the autofeather system is armed (fig. 2-36, 2-37). Both lights will be extinguished if either propeller has been autofeathered or if the system is disarmed by retarding a power lever. Both lights may be dimmed by rotating the cover. Autofeather circuits are protected by one 5-ampere circuit breaker placarded PROP FEATHER, located on the right subpanel (fig. 2-13, 2-14).

2-48. Propeller Governors.

Each propeller system utilizes three governors, one "primary" and two "backup", to control propeller RPM. Each propeller lever established RPM for the respective propeller by altering the setting for a primary governor attached to the engine gear reduction housing. It is the primary governor which controls RPM through the entire range. Should a primary governor malfunction (exceeding 2200 RPM) an overspeed governor cuts-in (2248 to 2328 RPM), dumping oil from the propeller to prevent RPM from exceeding safe limits. A solenoid actuated by the PROP GOV TEST switch enables the overspeed governor to be reset for test purposes (1980 to 2060 RPM). If a propeller should stick or move too slowly during a transient condition, the corresponding governor would be unable to prevent an overspeed condition. To provide for this contingency, the engine power turbine governor acts as a fuel topping governor. Thus, when the propeller RPM reaches 2332 RPM, this governor limits the fuel flow into the engine thereby reducing the power driving the propeller. During propeller operation in the reverse range, the engine power turbine governor will automatically be reset to allow a maximum of 2040 RPM.

2-49. Propeller Governor Test Switches.

Two, three-position switches on the left subpanel, are provided for operational test of the propeller systems (fig. 2-13, 2-14). Placarding above the switches reads PROP GOV TEST, LEFT, RIGHT. Placarding below reads SECONDARY IDLE STOP TEST. Each switch is a double unit, controlling two different test circuits for the corresponding propeller. In up position, the switches are used to test the function of the corresponding overspeed governor. In the down position, the switches are used to test function of the corresponding secondary low pitch stop. Each switch is spring-loaded to the OFF (center) position. Refer to chapter 8, for steps of both test procedures. Propeller test circuits are protected by one 5-ampere circuit breaker, placarded PROP GOV IDLE STOP, located on the right subpanel (fig. 2-13, 2-14).

2-50. Propeller Levers.

Two propeller levers on the control pedestal, placarded PROP, are used to regulate propeller speeds (fig. 2-11, 2-12). Each lever controls a primary governor, which acts to regulate propeller speeds within the normal operating range. The full levers forward position is placarded TAKEOFF, LANDING AND REVERSE - and also HIGH RPM. Full levers aft position is placarded FEATHER. When a lever is placed at HIGH RPM, the propeller may attain a static RPM of 2200, depending upon power lever position. As a lever is moved aft, passing through the propeller governing range, but stopping at the feathering detent, propeller RPM will correspondingly decrease to the lowest limit. Moving a propeller lever aft past the detent into FEATHER will feather the propeller.

2-51. Propeller Reversing.

CAUTION

Moving the power levers into reverse range without the engine running will result in damage to the reverse linkage mechanisms.

CAUTION

To prevent damage to reversing linkage and an asymmetric thrust condition, propeller levers must be in HIGH RPM position prior to propeller reversing.

The propeller blade angle may be reversed to shorten landing roll. To reverse, propeller levers are positioned at HIGH RPM (full forward), and the power levers are lifted up to pass over an IDLE detent, then pulled aft into REVERSE setting. In REVERSE position, each power lever overrides of the corresponding secondary idle stop, allowing engine power for the beta and reverse ranges. Power levers must be pulled back through normal idle speed range before being positioned in REVERSE.

a. Propeller Reverse Not-Ready Annunciator Light. One yellow caution light, placarded PROP REV NOT READY, on the annunciator panel alerts the pilot not to reverse the propellers (fig. 2-36, 2-37). This light illuminates only when the landing gear handle is down, and if propeller levers are not at HIGH RPM (full forward). This circuit is protected by a 5-ampere circuit breaker, placarded LDG GR RELAY, located on the right subpanel (fig. 2-13, 2-14).

b. Propeller Secondary Low-Pitch Stop Lights. Two red fault lights, placarded LH SECONDARY LOW PITCH STOP and RH SECONDARY LOW PITCH STOP, are located on the annunciator panel (fig. 2-36, 2-37). Illumination of a light indicates malfunction of the normal propeller low-pitch stop, and that a backup system designated the secondary idle stop functions for the affected propeller. Propeller reverse pitch operation must not be attempted while either of these lights are illuminated. Refer to chapter 9.

2-52. Propeller Tachometers.

Two tachometers on the instrument panel register propeller speed in hundreds of RPM (fig. 2-36, 2-37). Each indicator is slaved to a tachometer generator unit attached to the corresponding engine.

Section VII. UTILITY SYSTEMS

2-53. Defrosting System.

a. Description. The defrosting system is an integral part of the heating and ventilating system. The system consists of two warm air outlets connected by ducts to the heating system. One outlet is just below the pilot's windshield and the other is below the copilot's windshield. A push-pull control, placarded DEFROST AIR, on the right subpanel, manually controls airflow to the windshield (fig. 2-13, 2-14). When pulled out, defrosting air is ducted to the windshield. As the control is pushed in, there is a corresponding decrease in airflow.

b. Normal Operation.

1. Vent blower operation – CHECK.
2. HTR switch – AUTO.
3. CABIN TEMP control – As required.
4. CABIN AIR, VENT AIR, and DEFROST AIR controls – As required.

NOTE

For maximum windshield defrosting, pull out the CABIN AIR, VENT AIR, and DEFROST AIR controls and position the HTR switch to MAN. Regulate the temperature by opening one or more of the cold air outlets.

c. Emergency Operation. If the automatic temperature control should fail to operate, the temperature (of defrost air and cabin air) may be controlled manually by manipulating the HTR control switch betwee ne OFF and MAN positions.

2-54. Surface Deice System.

a. Description. Ice accumulation is removed from each outboard wing leading edge, both horizontal stabilizers, the vertical stabilizer and all mission antennas by the flexing of deicer boots which are pneumatically actuated. Engine bleed air, from the engine compressor, is used to supply air pressure to inflate the deicer boots, and to supply vacuum, through the ejector system, for boot hold down during flight. A pressure regulator protects the system from over inflation. When the system is not in operation, a distributor valve applies vacuum to the boots for hold-down. When a solenoid in the distributor valve is energized by the pneumatic deicer timer, or when the surface DEICE CYCLE switch is positioned to MANUAL, a servo valve changes the inlet to the boots from vacuum to pressure which allows the boots to inflate. When the solenoid valve is de-energized, the airflow through the valve is cutoff. The air then discharges out of the boots through an integral check valve until the pressure reaches approximately 1 in. Hg., at which time the boots are ported to vacuum and the remaining air is evacuated. The boots are again held down by vacuum.

(1) Either engine is capable of providing sufficient bleed air for all requirements of the surface deicer system. Check valves in the bleed air and vacuum lines prevent backflow through the system during single-engine operation. Bleed air passes through a 16 PSI regulator and then enters the deicer and vacuum systems. Vacuum pressure is created by the ejector and is proportional to pneumatic pressure supplied by the deicer pressure regulator valve. Regulated pressure is indicated on a gage, placarded DE-ICING PRESSURE, located on the control pedestal (fig. 2-11, 2-12).

(2) The operation of the surface deicer system is controlled by one three-position switch located on the left subpanel, placarded DEICE CYCLE, SINGLE, OFF, MANUAL (fig. 2-13, 2-14). The surface and antenna deicer system is protected by a 5-ampere circuit breaker, placarded SURF DEICE located on the right subpanel.

b. Normal Operation.

(1) Deicer boots are intended to remove ice after it has formed rather than prevent its formation. For the most effective deicing operation, allow at least 1/2 inch of ice on the surface boots to accumulate before attempting ice removal. Very thin ice may crack and cling to the boots instead of shedding.

NOTE

Never cycle the system rapidly – since this may cause the ice to accumulate outside the contour of the inflated boots and prevent ice removal.

(2) Normal operation of the surface deice system is accomplished by use of four-position switch located on the left subpanel, placarded DEICE CYCLE, SINGLE, OFF, MANUAL. When the switch is moved to the SINGLE position (momentary), the deicer boots automatically inflate for seven to eight seconds then deflate and return to the vacuum hold down position. When switched to the MANUAL position (momentary), all boots inflate and stay inflated while the switch is in this mode. When the switch is released from the MANUAL position, the boots deflate and the toggle returns to the center OFF position. The MANUAL position is for use in case of timer failure. In either switch position, the boots cannot be over-inflated.

2-55. Propeller Electrothermal Deicer System.

a. Description. Electrothermal deicer boots are cemented to each propeller blade to prevent ice formation or to remove ice from the propellers. Each thermal boot consists of one outboard and one inboard heating element, and receives electrical power from the deicer timer. This timer sends current to all propeller thermal boots and prevents the deicers from overheating by limiting the time each element is energized. Four intervals of approximately 30 seconds each complete one cycle. Current consumption is monitored by a PROP AMMETER on the left subpanel (fig. 2-13, 2-14). A 20-ampere circuit breaker switch placarded HEAT-PROP, OFF, on the left subpanel, controls the propeller electrothermal deicer system (fig. 2-13, 2-14).

b. Normal Operation. Operation of the propeller deicing system is controlled by a switch, placarded HEAT-PROP, OFF, which controls two inboard and outboard heating elements in each propeller boot. When ice formation becomes visible on the aircraft, or when ice is expected, place this switch in the HEAT - (PROP) position. The timer will then cycle power to the heating elements. The timer successively delivers current to the outer heaters on one propeller, the inner heaters on the same propeller, the outer heaters on the opposite propeller and the heaters on the same propeller. The timer energizes each of these four phases in turn for about 30 seconds and then repeats the cycle as long as the control switch is on. When the timer shuts off, it advances one cycle. Each cycle is 30 seconds in duration, which makes a complete cycle lasting two minutes. When the timer switches from one phase to the next, the ammeter will register a momentary deflection. These fluctuations inform the pilot that the timer is switching properly.

NOTE

> On aircraft equipped with electronic timers, cycle switching occurs very rapidly and may or may not be detectable as a flicker of the ammeter needle. These timers cannot be manually stepped through cycles by alternately energizing and de-energizing the system on/off switch.

Heating may begin at any phase in the cycle depending on the timer position when the switch was turned off from previous use. If ammeter readings are above or below the operating limits, propeller unbalance may occur when operating in icing conditions.

2-56. Pitot and Static System.

a. Description. The pitot and static system supplies static pressure to two airspeed indicators, two altimeters, two vertical velocity indicators, and ram air to the airspeed indicators. This system consists of a single pitot tube attached to the underside of the left wing leading edge, static air pressure ports in the aircraft's exterior skin on each side of the aft fuselage, and associated system plumbing. The pitot head is protected from ice formation by internal electric heating elements. Refer to Pitot and Stall Warning Heat System, Section VIII.

b. Emergency Static Air Source. A knob type control valve located at the upper right corner of the instrument panel permits the selection of an alternate static air pressure source. It is placarded EMERGENCY STATIC AIR SOURCE, NORM OFF. The normal operating position (NORM OFF) supplies static air pressure from the external pressure ports on the aft fuselage. When required, static pressure may be obtained from the alternate source by rotating the control knob counterclockwise. For airspeed calibration, when using the emergency static air source, refer to chapter 7.

2-57. Pitot and Stall Warning Heat System.

a. Description. The pitot tube and the stall warning vane have electrical heating elements to prevent icing. Each heating element is controlled by the same, 10-ampere, circuit breaker type switch, located on the left subpanel, placarded HEAT, LH PITOT (fig. 2-13, 2-14).

b. Normal Operation. When the pitot heat switch is in the HEAT (LH) position, the heating element of both the stall warning vane and the exposed portion of the pitot tube are energized. The PITOT (off) position shuts both heating elements off. In the event of overload, the circuit breaker element of the switch will disconnect both heating circuits, tripping the toggle to a down position. To reset power to a heating circuit, move the switch toggle to up position.

CAUTION

> Pitot or stall warning heat should not be used for more than 15 minutes while the aircraft is on the ground. Overheating may damage the heating elements.

2-58. Fuel System Anti-Icing.

a. Description. An oil-to-fuel heat exchanger, located on each engine accessory case, operates continuously and automatically to heat the fuel sufficiently to prevent freezing of any water in the fuel. No controls are involved. One external fuel vent on each wing serves both the nacelle and wing tanks and is protected against icing by externally attached electric heat elements, controlled by two 5-ampere circuit breaker toggle switches on the left subpanel, placarded HEAT - FUEL VENTS, LEFT, RIGHT (fig. 2-13, 2-14).

CAUTION

> To prevent overheat damage to electrically heated anti-ice jackets, FUEL VENT HEAT, switches should not be turned ON unless cooling air will soon pass over the jacks.

b. Normal Operation. For normal operation, HEAT switches for the FUEL VENTS anti-ice circuits are turned ON as required during the BEFORE TAKEOFF procedures. FUEL

CONTROL, HEAT switches are turned ON during the STARTING ENGINES procedures. Refer to chapter 8.

2-59. Windshield Electrothermal Anti-ice Systems.

a. Description. Both pilot and copilot windshields are provided with an independent electrothermal anti-ice system. Each system is composed of the windshield assembly with heating wires sandwiched between glass panels, a temperature sensor attached to the glass, and electrothermal controller, a relay switch, control switches and two circuit breakers (fig. 2-13, 2-14). Two ON-OFF switches, placarded WINDSHIELD ANTI-ICE - PILOT, COPILOT, are located on the left subpanel (fig. 2-13, 2-14). Each switch controls one electrothermal windshield system. The circuits of each system are protected by a respective ½-ampere circuit breaker and a respective 25-ampere circuit breaker on the right subpanel, placarded WINDSHIELD ANTI-ICE - PILOT, COPILOT (fig. 2-13, 2-14).

b. Normal Operation. Each electrothermal windshield is activated by placing the corresponding WINDSHIELD ANTI-ICE switch to ON position. If glass temperature is below 43°C, the electrothermal controller will actuate a relay switch applying power to the heating wires sandwiched within the glass. A windshield will warm to a maximum of 43°C and then cycle off. A windshield will recycle ON again when the glass temperature drops 25°C below cutoff. Refer to chapter 8.

2-60. Oxygen System.

a. Description **RU-21A** The pilot, copilot and both operator stations are provided with diluter-demand oxygen supply systems (fig. 2-25) ,which mix the proper amount of oxygen for a given amount of air at altitude. The oxygen supply is provided by two 64-cubic foot pressure cylinders. One cylinder is installed in the nose of the aircraft and the other is located behind the copilot seat attached to the fuselage wall. Each cylinder has a pressure gage. The system provides individual regulator panels (identical) for all crew members. System pressure gages, placarded OXYGEN SUPPLY PRESSURE are located, each below the fuel management panel. A third gage is located adjacent to the oxygen filler valve. Cockpit gages register pressure of the forward and aft oxygen supplies. The gage at the filler valve registers overall system pressure. Oxygen is routed by high pressure tubing from the oxygen filler valve to the adjacent system pressure gage, and through check valves to the forward and aft oxygen cylinder. Oxygen from both cylinders flows through check valves to pressure gages on the left wall of the cockpit and to a pressure reducer which reduces system pressure to a suitable working level (400 PSI). Oxygen then flows by low pressure tubing to check valves which interconnect fore and aft systems, and on to diluter demand regulators. Demand regulators regulate oxygen flow to oxygen outlets independently of each other. Table 2-3 shows oxygen duration and system capacities.

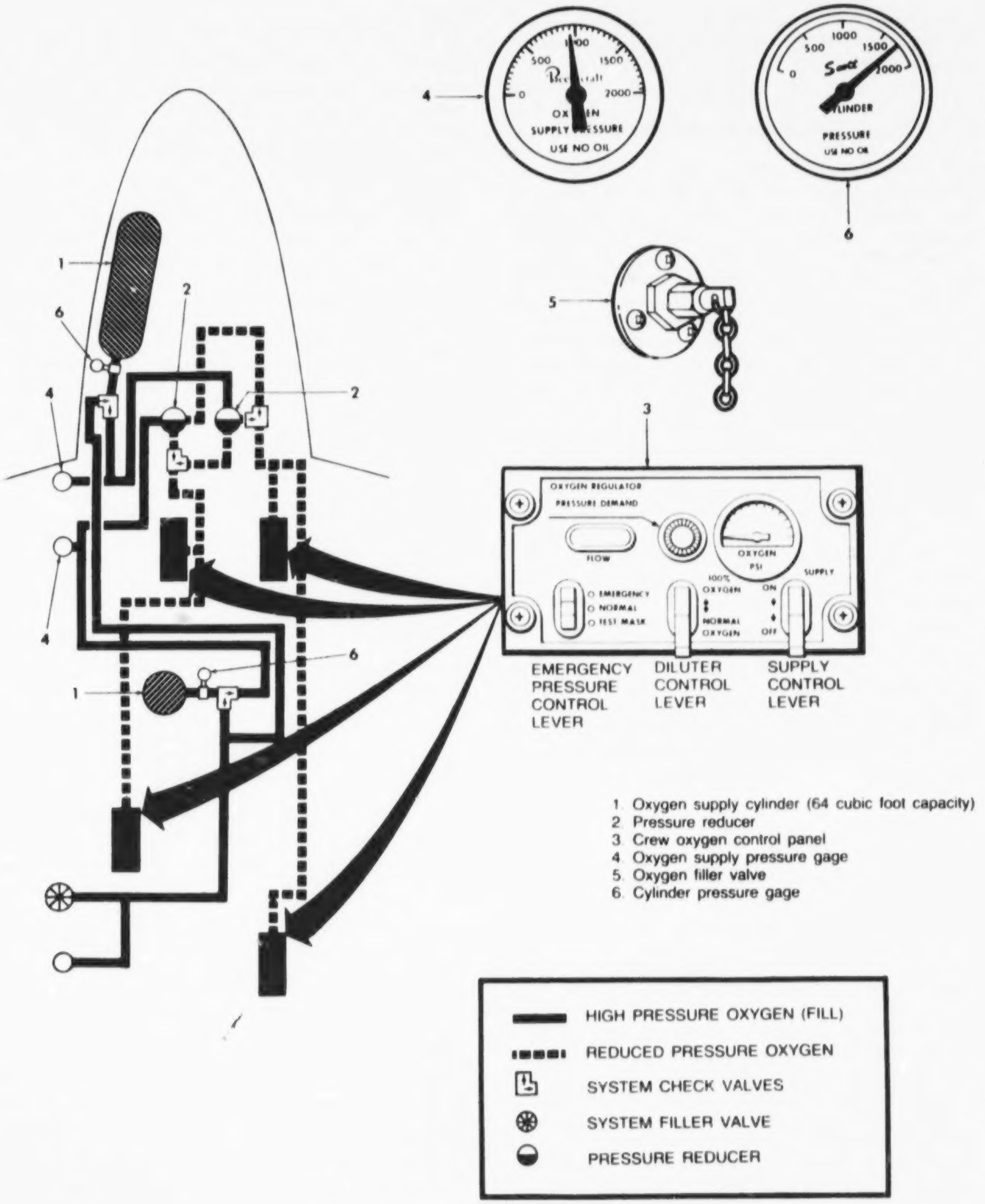
(1) *Regulator control panels.* The pilot's oxygen regulator control panel is located on the cockpit sidewall below the fuel management panel. The copilot's oxygen regulator control panel is located on the cockpit sidewall below the copilot's circuit breaker and fuse panel. Mission operator regulator panels are located in the cabin adjacent to operator chairs. Each panel contains a blinker-type flow indicator, a 2000 PSI gage, a red emergency pressure control lever placarded: EMERGENCY-NORMAL-TEST MASK, a white diluter control lever placarded 100% OXYGEN and NORMAL OXYGEN and a green supply control lever placarded ON/OFF. The supply control lever turns the individual regulator ON and OFF. The diluter control lever gives the selection of either NORMAL or 100% OXYGEN, but acts to select only when the emergency pressure control lever is placed in NORMAL position (fig. 2-25).

CAUTION

When not in use, the diluter control lever should be left in the 100% OXYGEN position to prevent regulator contamination.

(a) The emergency pressure control lever has three positions - two positions control oxygen consumption for the individual using oxygen, and the remaining position serves for testing hose and mask integrity. In the EMERGENCY position, the control lever causes 100% oxygen to be delivered at a safe, positive pressure. In NORMAL position, the lever allows delivery of normal or 100% oxygen depending upon the selection of the diluter control lever. In TEST MASK position 100% oxygen at positive pressure is delivered to check hose and mask integrity.

(b) The 2000 PSI oxygen pressure gage provided on the oxygen control panels should at no time indicate over 400 PSI. If the pressure



1. Oxygen supply cylinder (64 cubic foot capacity)
2. Pressure reducer
3. Crew oxygen control panel
4. Oxygen supply pressure gage
5. Oxygen filler valve
6. Cylinder pressure gage

▬	HIGH PRESSURE OXYGEN (FILL)
▪▪▪▪	REDUCED PRESSURE OXYGEN
⊡	SYSTEM CHECK VALVES
⊛	SYSTEM FILLER VALVE
◒	PRESSURE REDUCER

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Figure 2-25. Oxygen Supply System **RU-21A**

Table 2-3. Oxygen Duration RU-21A *(sheet 1 of 2)*

CREW MEMBER DURATION IN HOURS

	CABIN ALTITUDE FEET	GAGE PRESSURE – PSI, RU – 21A 64 CUBIC FOOT SYSTEM						
		2000	1800	1500	1200	900	600	300
ONE MAN CREW	**10,000**	3.6 12.5	3.2 11.3	2.7 9.4	2.1 7.5	1.6 5.6	1.1 3.7	0.5 1.8
	15,000	4.4 12.5	4.0 11.3	3.3 9.4	2.6 7.5	2.0 5.6	1.3 3.7	0.6 1.8
	20,000	5.9 10.4	5.3 9.3	4.4 7.8	3.5 6.2	2.6 4.6	1.7 3.1	0.9 1.5
TWO MAN CREW	**10,000**	1.8 6.3	1.6 5.6	1.3 4.7	1.1 3.7	0.8 2.8	0.5 1.9	0.3 0.9
	15,000	2.2 6.3	2.0 5.6	1.7 4.7	1.3 3.7	1.0 2.8	0.7 1.9	0.3 0.9
	20,000	2.9 5.2	2.7 4.7	2.2 3.9	1.8 3.1	1.3 2.3	0.9 1.5	0.4 0.8
THREE MAN CREW	**10,000**	1.2 4.2	1.1 3.8	0.9 3.1	0.7 2.5	0.5 1.9	0.4 1.2	0.2 0.6
	15,000	1.5 4.2	1.3 3.8	1.1 3.1	0.9 2.5	0.7 1.9	0.4 1.2	0.2 0.6
	20,000	2.0 3.5	1.8 3.1	1.5 2.6	1.2 2.1	0.9 1.5	0.6 1.0	0.3 0.5
FOUR MAN CREW	**10,000**	0.9 3.1	0.8 2.8	0.7 2.3	0.5 1.9	0.4 1.4	0.3 0.9	0.1 0.5
	15,000	1.1 3.1	1.0 2.8	0.8 2.3	0.7 1.9	0.5 1.4	0.3 0.9	0.2 0.5
	20,000	1.5 2.6	1.3 2.3	1.1 1.9	0.9 1.5	0.7 1.2	0.4 0.8	0.2 0.4

NOTES:
1. Top figures indicate 100 percent oxygen mode.
2. Bottom figures indicate normal oxygen, diluter-demand mode.
3. For conservative time estimates, use next lower gage pressure.

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Table 2-3. Oxygen Duration **RU-21A** *(sheet 2 of 2)*

CREW MEMBER DURATION IN HOURS

	CABIN ALTITUDE FEET	GAGE PRESSURE – PSI, RU – 21A 128 CUBIC FOOT SYSTEM						
		2000	1800	1500	1200	900	600	300
ONE MAN CREW	10,000	7.2	6.4	5.4	4.3	3.2	2.1	1.0
		25.0	22.5	18.8	15.0	11.2	7.4	3.6
	15,000	8.8	8.0	6.6	5.3	4.0	2.6	1.3
		25.0	22.5	18.8	15.0	11.2	7.4	3.6
	20,000	11.8	10.6	8.8	7.0	5.3	3.5	1.7
		20.7	18.6	15.5	12.4	9.3	6.1	3.0
TWO MAN CREW	10,000	3.6	3.2	2.7	2.1	1.6	1.1	0.5
		12.5	11.3	9.4	7.5	5.6	3.7	1.8
	15,000	4.4	4.0	3.3	2.6	2.0	1.3	0.6
		12.5	11.3	9.4	7.5	5.6	3.7	1.8
	20,000	5.9	5.3	4.4	3.5	2.6	1.7	0.9
		10.4	9.3	7.8	6.2	4.6	3.1	1.5
THREE MAN CREW	10,000	2.4	2.1	1.8	1.4	1.1	0.7	0.3
		8.3	7.5	6.3	5.0	3.7	2.5	1.2
	15,000	2.9	2.7	2.2	1.8	1.3	0.9	0.4
		8.3	7.5	6.3	5.0	3.7	2.5	1.2
	20,000	3.9	3.5	2.9	2.3	1.8	1.2	0.6
		6.9	6.2	5.2	4.1	3.1	2.0	1.0
FOUR MAN CREW	10,000	1.8	1.6	1.3	1.1	0.8	0.5	0.3
		6.3	5.6	4.7	3.7	2.8	1.9	0.9
	15,000	2.2	2.0	1.7	1.3	1.0	0.7	0.3
		6.3	5.6	4.7	3.7	2.8	1.9	0.9
	20,000	2.9	2.7	2.2	1.8	1.3	0.9	0.4
		5.2	4.7	3.9	3.1	2.3	1.5	0.8

NOTES:
1. Top figures indicate 100 percent oxygen mode.
2. Bottom figures indicate normal oxygen, diluter-demand mode.
3. For conservative time estimates, use next lower gage pressure.

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exceeds 400 PSI, a malfunction of the pressure reducer is indicated. Whenever oxygen is inhaled, a blinker-vane slides into view within the flow indicator window, showing that oxygen is being released. When oxygen is exhaled, the blinker-vane vanishes from view.

NOTE

Check to insure that the OXYGEN SUPPLY PRESSURE gage registers adequate pressure before each flight. A check of the supply pressure should be made at intervals during flight to note the quantity available and to approximate the supply duration. The outside temperature is reduced as an aircraft ascends to higher altitudes. Oxygen cylinders thus cooled by temperature change will show a pressure drop. This type of drop in pressure will raise again upon return to a lower or warmer altitude. A valid cause for alarm would be the rapid loss of oxygen pressure when the aircraft is in level flight or descending; should this condition arise, descend as rapidly as possible to an altitude which does not require the use of oxygen.

WARNING

Pure oxygen will support combustion. Do not smoke while oxygen is in use.

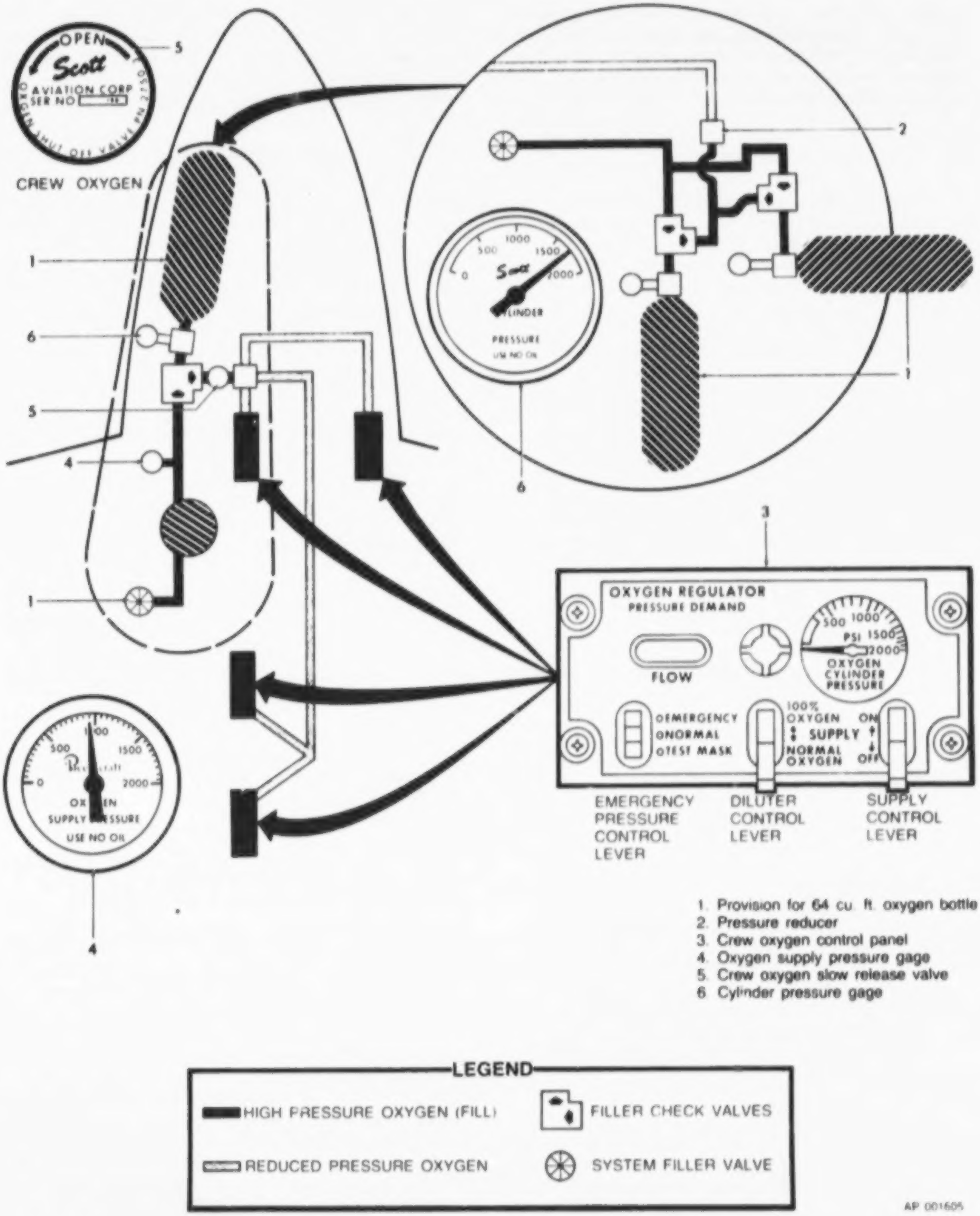
WARNING

If any symptoms occur suggestive of the onset of hypoxia, immediately set the emergency pressure control lever to the EMERGENCY position and descend below 10,000 feet. Whenever carbon monoxide or other noxious gas is present or suspected, set the diluter control lever to 100% OXYGEN and continue breathing undiluted oxygen until the danger is past.

(2) Oxygen masks. Oxygen masks are provided as personal equipment. To connect a mask into the oxygen system, the individual connects the line attached to the mask to the flexible hose which is attached to the cockpit sidewall. The microphone in the oxygen mask is provided with a cord for connecting with the helmet microphone jack. To test mask and hose integrity the individual places the supply control lever on the regulator control panel to the ON position, dons and adjusts his mask, selects TEST MASK position, and checks for leaks.

b. Description **RU-21D** The pilot, copilot and both operator stations are provided with diluter-demand oxygen supply systems (fig. 2-26), which mix the proper amount of oxygen for a given amount of air at altitude. The oxygen supply is provided by two 64-cubic foot pressure cylinders. One cylinder is installed in the nose of the aircraft and the other is located behind the pilot seat attached to the fuselage wall. Each cylinder has a pressure gage. The system provides individual regulator panels (identical) for all crew members. The system pressure gage, placarded OXYGEN SUPPLY PRESSURE, is located aft of the fuel management panel. This gage shows the amount of pressure remaining in the oxygen supply cylinders. Supply lines from the cylinders are routed to two high pressure, slow-release valves located below the fuel management panel. Each oxygen supply valve has a flow governing feature controlled by an integral pressure differential sensor. When initially turned ON by the pilot, only a small flow is allowed to meter into the line. Flow restriction continues until the pressure levels are equalized, at which time the valve opens up completely, permitting a full flow condition. The forward valve, placarded CREW OXYGEN, controls high pressure flow to a pressure reducer located on the forward cabin wall behind the instrument panel. This reducer lowers pressure to a 300 to 400 PSI range and routes oxygen to the regulator control panels. Table 2-4 shows oxygen duration and system capacities.

(1) Regulator control panels. The pilot's oxygen regulator control panel is located on the cockpit sidewall below the fuel management panel. The copilot's oxygen regulator control panel is located on the cockpit sidewall below the copilot's circuit breaker and fuse panel. Mission operator regulator panels are located in the cabin adjacent to operator chairs. Each panel contains a blinker-type flow indicator, a 2000 PSI gage, a red emergency pressure control lever placarded: EMERGENCY-NORMAL-TEST MASK, a white diluter control lever placarded 100% OXYGEN and NORMAL OXYGEN, and a green supply control lever placarded ON/OFF. The supply control lever turns the individual regulator ON and OFF. The diluter control lever gives the selection of either NORMAL or 100% OXYGEN, but acts to select only when the emergency pressure control lever is placed in NORMAL position (fig. 2-26.)



1. Provision for 64 cu. ft. oxygen bottle
2. Pressure reducer
3. Crew oxygen control panel
4. Oxygen supply pressure gage
5. Crew oxygen slow release valve
6. Cylinder pressure gage

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Figure 2-26. Oxygen Supply System **RU-21D**

Table 2-4. Oxygen Duration RU-21D *(sheet 1 of 2)*

CREW MEMBER DURATION IN HOURS

	CABIN ALTITUDE FEET	GAGE PRESSURE-PSI, RU-21D 64 CUBIC FOOT SYSTEM						
		2000	1800	1500	1200	900	600	300
ONE MAN CREW	10,000	3.6 12.5	3.2 11.3	2.7 9.4	2.1 7.5	1.6 5.6	1.1 3.7	0.5 1.8
	15,000	4.4 12.5	4.0 11.3	3.3 9.4	2.6 7.5	2.0 5.6	1.3 3.7	0.6 1.8
	20,000	5.9 10.4	5.3 9.3	4.4 7.8	3.5 6.2	2.6 4.6	1.7 3.1	0.9 1.5
TWO MAN CREW	10,000	1.8 6.3	1.6 5.6	1.3 4.7	1.1 3.7	0.8 2.8	0.5 1.9	0.3 0.9
	15,000	2.2 6.3	2.0 5.6	1.7 4.7	1.3 3.7	1.0 2.8	0.7 1.9	0.3 0.9
	20,000	2.9 5.2	2.7 4.7	2.2 3.9	1.8 3.1	1.3 2.3	0.9 1.5	0.4 0.8
THREE MAN CREW	10,000	1.2 4.2	1.1 3.8	0.9 3.1	0.7 2.5	0.5 1.9	0.4 1.2	0.2 0.6
	15,000	1.5 4.2	1.3 3.8	1.1 3.1	0.9 2.5	0.7 1.9	0.4 1.2	0.2 0.6
	20,000	2.0 3.5	1.8 3.1	1.5 2.6	1.2 2.1	0.9 1.5	0.6 1.0	0.3 0.5
FOUR MAN CREW	10,000	0.9 3.1	0.8 2.8	0.7 2.3	0.5 1.9	0.4 1.4	0.3 0.9	0.1 0.5
	15,000	1.1 3.1	1.0 2.8	0.8 2.3	0.7 1.9	0.5 1.4	0.3 0.9	0.2 0.5
	20,000	1.5 2.6	1.3 2.3	1.1 1.9	0.9 1.5	0.7 1.2	0.4 0.8	0.2 0.4

NOTES:
1. Top figures indicate 100 percent oxygen mode.
2. Bottom figures indicate normal oxygen, diluter-demand mode.
3. For conservative time estimates, use next lower gage pressure.

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Table 2-4. Oxygen Duration RU-21D *(sheet 2 of 2)*

CREW MEMBER DURATION IN HOURS

	CABIN ALTITUDE FEET	GAGE PRESSURE-PSI, RU-21D 128 CUBIC FOOT SYSTEM						
		2000	1800	1500	1200	900	600	300
ONE MAN CREW	10,000	7.2 25.0	6.4 22.5	5.4 18.8	4.3 15.0	3.2 11.2	2.1 7.4	1.0 3.6
	15,000	8.8 25.0	8.0 22.5	6.6 18.8	5.3 15.0	4.0 11.2	2.6 7.4	1.3 3.6
	20,000	11.8 20.7	10.6 18.6	8.8 15.5	7.0 12.4	5.3 9.3	3.5 6.1	1.7 3.0
TWO MAN CREW	10,000	3.6 12.5	3.2 11.3	2.7 9.4	2.1 7.5	1.6 5.6	1.1 3.7	0.5 1.8
	15,000	4.4 12.5	4.0 11.3	3.3 9.4	2.6 7.5	2.0 5.6	1.3 3.7	0.6 1.8
	20,000	5.9 10.4	5.3 9.3	4.4 7.8	3.5 6.2	2.6 4.6	1.7 3.1	0.9 1.5
THREE MAN CREW	10,000	2.4 8.3	2.1 7.5	1.8 6.3	1.4 5.0	1.1 3.7	0.7 2.5	0.3 1.2
	15,000	2.9 8.3	2.7 7.5	2.2 6.3	1.8 5.0	1.3 3.7	0.9 2.5	0.4 1.2
	20,000	3.9 6.9	3.5 6.2	2.9 5.2	2.3 4.1	1.8 3.1	1.2 2.0	0.6 1.0
FOUR MAN CREW	10,000	1.8 6.3	1.6 5.6	1.3 4.7	1.1 3.7	0.8 2.8	0.5 1.9	0.3 0.9
	15,000	2.2 6.3	2.0 5.6	1.7 4.7	1.3 3.7	1.0 2.8	0.7 1.9	0.3 0.9
	20,000	2.9 5.2	2.7 4.7	2.2 3.9	1.8 3.1	1.3 2.3	0.9 1.5	0.4 0.8

NOTES:
1. Top figures indicate 100 percent oxygen mode.
2. Bottom figures indicate normal oxygen, dilutar-demand mode.
3. For conservative time estimates, use next lower gage pressure.

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CAUTION

When not in use, the diluter control lever should be left in the 100% OXYGEN position to prevent regulator contamination.

(a) The emergency pressure control lever has three positions, two positions control oxygen consumption for the individual using oxygen, and the remaining position serves for testing hose and mask integrity. In the EMERGENCY position, the control lever causes 100% oxygen to be delivered at a safe, positive pressure. In NORMAL position, the lever allows delivery of normal or 100% oxygen depending upon the selection of the diluter control lever. In TEST MASK position 100% oxygen at positive pressure is delivered to check hose and mask integrity.

(b) The 2000 PSI oxygen pressure gage provided on the oxygen control panels should at no time indicate over 400 PSI. If the pressure exceeds 400 PSI, a malfunction of the pressure reducer is indicated. Whenever oxygen is inhaled, a blinker-vane slides into view within the flow indicator window, showing that oxygen is being released. When oxygen is exhaled, the blinker-vane vanishes from view.

NOTE

Check to insure that the OXYGEN SUPPLY PRESSURE gage registers adequate pressure before each flight. A check of the supply pressure should be made at intervals during flight to note the quantity available and to approximate the supply duration. The outside temperature is reduced as an aircraft ascends to higher altitudes. Oxygen cylinders thus cooled by temperature change will show a pressure drop. This type of drop in pressure will raise again upon return to a lower or warmer altitude. A valid cause for alarm would be the rapid loss of oxygen pressure when the aircraft is in level flight or descending; should this condition arise, descend as rapidly as possible to an altitude which does not require the use of oxygen.

WARNING

Pure oxygen will support combustion. Do not smoke while oxygen is in use.

WARNING

If any symptoms occur suggestive of the onset of hypoxia, immediately set the emergency pressure control lever to the EMERGENCY position and descend below 10,000 feet. Whenever carbon monoxide or other noxious gas is present or suspected, set the diluter control lever to 100% OXYGEN and continue breathing undiluted oxygen until the danger is past.

(2) Oxygen masks. Oxygen masks for the pilot and copilot are provided as personal equipment. To connect a mask into the oxygen system, the individual connects the line attached to the mask to the flexible hose which is attached to the cockpit sidewall. The microphone in the oxygen mask is provided with a cord for connecting with the helmet microphone jack which is attached by a spring clip to the cockpit sidewall. To test mask and hose integrity the individual places the supply control lever on the regulator control panel to the ON position, dons and adjusts his mask, selects TEST MASK position, and checks for leaks.

c. Normal Operation. Oxygen pressure is maintained at all times to the regulator control panels if the cylinder shut-off valves are on and if there is pressure in the cylinders. Each individual places the supply lever (green) on his regulator control panel to the ON position, the diluter lever (white) to the NORMAL OXYGEN position.

NOTE

The shutoff valves of high pressure oxygen systems should be opened fully to prevent the possibility of leakage.

d. Emergency Operation. For emergency operation, the affected crew member selects the EMERGENCY position of the emergency pressure control lever on his oxygen regulator control panel. This selection provides 100% oxygen, at a positive pressure, regardless of the position of the diluter control lever on his panel.

2-61. Drift Sight Viewing Window.

a. Description. A covered viewing window (fig. 2-9, 2-10) is located at floor level forward of the copilot's seat to provide a means for updating orientation of the inertial Navigation System (INS) while flying the aircraft over a ground target with known coordinates. This sighting window has three basic components: a hinged floor cover - protecting the window surface when not in use, and two transparent sheets positioned one above the other in a horizontal plane. The two transparent plastic sheets have two intersecting, perpendicular lines. The lines on the upper sheet are directly above the lines on the lower sheet. The forward-to-aft line on each sheet is parallel to the aircraft center line, and the left-to-right lines are perpendicular.

b. Normal Operation. Prior to using the drift sight viewing window, the pilot must establish a level flight condition at a prescribed altitude, headed on a course which will pass the aircraft vertically over the ground reference target. As the aircraft approaches the ground target, the copilot should first locate the target using his side window, then transfer his attention quickly to view the target through the drift sight window. He should orient his head to a position which appears to superimpose the target at the intersect point of the wide lines on the top window and continue moving his head as necessary to hold the target superimposed at this point. When the ground reference target is directly underneath the aircraft, the intersecting wide lines on the two plastic sheets will be in exact vertical alignment, appearing as one set, with the target centered at the point of intersect. At this precise time, the copilot performs the action which updates the INS to the target coordinates. The accuracy of this technique is within the allowable tolerance for circular error compatible to the INS. Refer to chapter 3 for operational procedures for manual INS position update.

2-62. Windshield Wipers.

a. Description. Two electrically operated windshield wipers are provided for use at takeoff and landing speed (fig. 2-9, 2-10). Operation at cruise speeds may result in damage to the wiper operating mechanism. A rotary switch (fig. 2-35), placarded WINDSHIELD WIPER, located on the overhead control panel, selects mode of windshield wiper operation. An information placard below the switch states: DO NOT OPERATE ON DRY GLASS. Function positons on the switch, as read clockwise, are placarded: PARK - OFF - SLOW - FAST. When the switch is held in the spring-loaded PARK setting, the blades will return to their normal inoperative position on the glass, then, when released, the switch will return to OFF position terminating windshield wiper operation. The FAST and SLOW switch positions are separate operating speed settings for wiper operation. The windshield wiper circuit is protected by one 10-ampere circuit breaker, placarded WSHLD WIPER, located on the right subpanel (fig. 2-13, 2-14).

CAUTION

Do not operate windshield wipers on dry glass. Such action can damage the linkage as well as scratch the windshield glass.

b. Normal Operation. To start, turn WINDSHIELD WIPER switch to FAST or SLOW speed, as desired. To stop, turn the switch to the PARK position and release. The blades will return to their normal inoperative position and stop. Turning the switch only to the OFF position will stop the windshield wipers, without returning them to the normal inactive position.

2-63. Stall Warning System.

Approach to a stall is indicated by a steady tone of a warning horn located behind the right subpanel. A small metal vane located on the left wing leading edge, is moved by any change in airflow over the leading edge of the wing. Movement of the vane as the aircraft approaches a stalled condition actuates a switch which completes a DC electrical circuit to the stall warning horn. Since the vane is affected by the same aerodynamic forces that result in the stall, the system functions regardless of the type of stall or configuration of landing gear and wing flaps, the only variation in performance being the margin of airpseed at which the warning occurs. To prevent ice formations on the stall warning vane an electrically operated heating element is installed which is controlled by the LH PITOT circuit breaker switch on the left subpanel. The stall warning circuit is protected by a 5-ampere circuit breaker, placarded STALL WARN HORN, on the right subpanel (fig. 2-13, 2-14), and a 5-ampere circuit breaker placarded STALL WARNING CKT BKR on a bracket below the battery box in the right center wing section (fig. 2-29, 2-31).

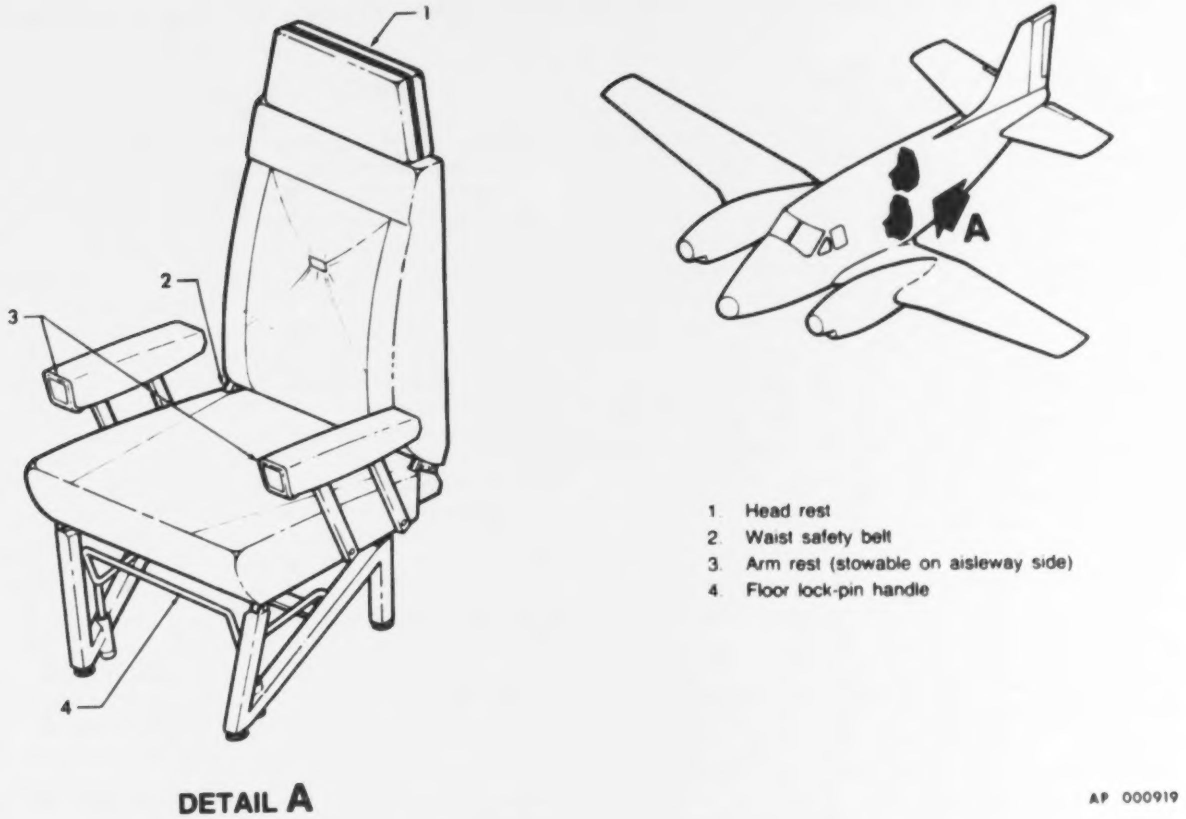

Figure 2-27. Mission Operator Seat RU-21A

2-64. Operator Seats.

a. Operator Seats RU-21A Two cushioned chair seats, with arm rests, are located in the cabin for the mission operators (fig. 2-27). One seat is located on each side of the center aisleway, facing forward, and attaches to floor tracks. A lever on the seat base allows the occupant to control vertical height adjustment and to rotate the seat within a range of approximately 360 degrees. Each seat is equipped with a waist level safety belt.

b. Operator Seats RU-21D Two operator seats are mounted on the left side of the cabin facing the mission console (fig. 2-28). The seat legs can be released from floor-mounted tracks and the seat may be folded back against the bulkhead to facilitate easy access to the cockpit and to provide additional working space at the console. The sitting surface attaches to brackets on the cabin sidewall channel. The sides and backs of the seats are comprised of a web material which attaches to fitting anchors on aircraft structure. The seat is not adjustable.

2-65. Cigarette Lighters and Ash Trays.

One electrical push-in type cigarette lighter receptacle is located on the control pedestal (fig. 2-11, 2-12). A push-pull type ash tray is built into the inboard arm rest of the pilot and copilot seats. The circuit for the pilot's cigarette lighter is protected by a 5-ampere circuit breaker, placarded CIGARETTE LIGHTER COCKPIT, on the right subpanel (fig. 2-13, 2-14).

2-66. Relief Tubes.

Two relief tubes are provided, one under the pilot's seat and one on the left side of the cabin.

2-67. Rear View Mirror.

A single rear-view type mirror is externally mounted below the pilot's side window to enable surveillance along the left fuselage and aft tail surfaces (fig. 2-9, 2-10). Sighting angle of the mirror

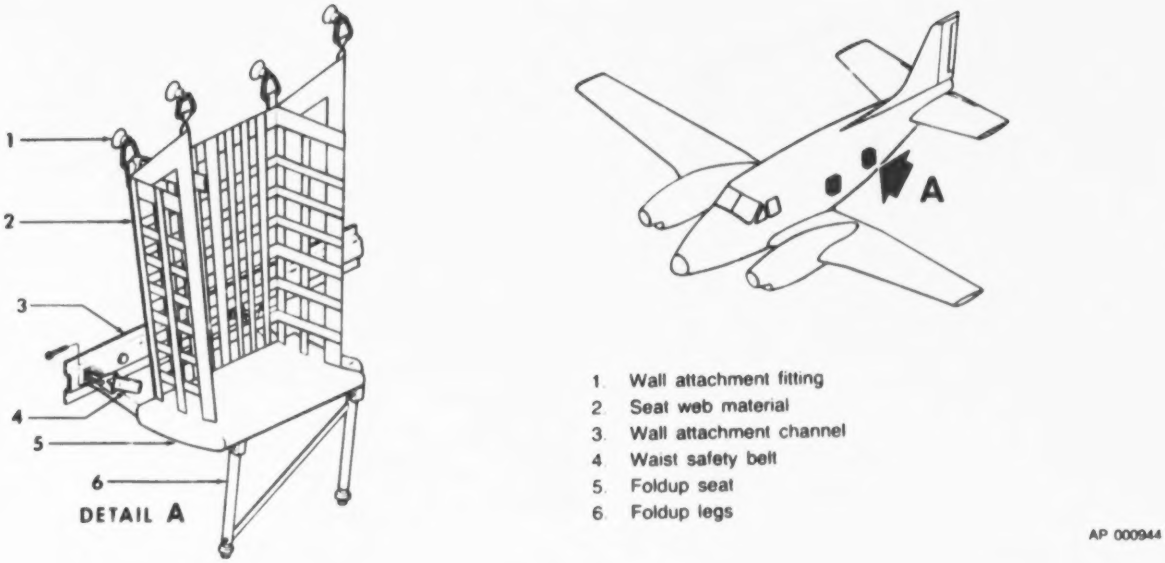

Figure 2-28. Mission Operator Seat (RU-21D)

is adjustable from within the cockpit using a rotary control knob located aft of the fuel managment panel (fig. 2-9, 2-10). When not in use, the mirror may be adjusted to streamline against the fuselage exterior for minimum drag.

2-68. Sun Visors.

CAUTION

When adjusting the sun visors, grasp only by the top metal attachment to avoid damage to the plastic shield.

Two sun visors are provided for the pilot and copilot respectively (fig. 2-9, 2-10). Each visor is manually adjustable. When not needed as a sun shield, each visor may be manually rotated to a position flush with the top of the cockpit so that it does not obstruct view through the windows.

2-69. Thermos Bottles.

Two half-gallon capacity thermos bottles are contained in a wall-mounted bottle holder (fig. 2-3, 2-4) located in the aft end of the cabin.

2-70. Rifle Rack.

A rifle rack (fig. 2-3, 2-4) with provisions for five M-16 rifles is mounted on the forward side of the bulkhead in the aft end of the cabin. The top part of the rack has a push-pull type pin which must be pulled to allow the front half of the padded rack to hinge forward allowing rifle installation or removal.

2-71. Tape Storage Container. RU-21D

A tape deck (cassette) storage container is mounted on the mission console and has storage capacity for five tapes. The container lid, placarded UNH-6 TAPE STORAGE, is spring-loaded to the closed position. Two, hand operated, twist type fasteners secure the removable container in its mounting bracket.

2-72. Plotting Board. RU-21D

CAUTION

The plotting board must be stowed prior to takeoff, landing, or any maneuvering flight.

The copilot's plotting board is stowed in a rack behind the pilot's seat (fig. 2-10). The board is secured in the rack by a hand operated, twist type fastener.

Section VIII. HEATING, VENTILATION, COOLING, AND ENVIRONMENTAL CONTROL UNIT

2-73. Heating and Ventilating Systems.

a. Description. The heating and ventilation system operates utilizing fresh air from outside of the aircraft. On the ground, the outside air enters the system cold air plenum through the ventilation louvers in the left door of the nose avionics compartment. A ventilation air blower operates only while the aircraft is on the ground, forcing air from the nose avionics compartment into the cold air plenum. When the aircraft becomes airborne, a switch on the left main landing gear strut turns the blower off. Part of the ram air bypasses the heater and is ducted to the nose avionics compartment, and to the cold air outlets in both the cockpit and cabin. The remainder of the air is ducted into the heater. After the air is heated, it is ducted to three warm air outlets in the cabin, and to the two warm air and defroster outlets in the cockpit. The cockpit's warm air outlets are just above each set of rudder pedals. The cabin warm air outlets are located at floor level. Stale air is vented through the exhaust air plenum installed in the cabin ceiling. There is also an exit air duct installed in the aft cabin floor.

(1) INS blower. The computer and platform units of the Inertial Navigation System (INS) in the aft cabin compartment, have a separate air flow cooling system. During flight ram air enters an inlet scoop on the fuselage left side. The blower unit operates whenever the INS system is activated. Refer to chapter 3.

(2) Vent blower and switch. A switch, placarded VENT BLWR, on the right subpanel, controls activation of the blowers for the ventilation system (fig. 2-13, 2-14). VENT BLWR position, activates the ventilation blowers for cooling air when the aircraft is on the ground. When the aircraft becomes airborne, a switch on the left main gear turns the ventilation blower circuits off. Circuits are protected by a 20-ampere circuit breaker placarded VENT BLOWER POWER located on the copilot's circuit breaker and fuse panel (fig. 2-29, 2-31).

(3) Fresh air outlets. Fresh air is ducted directly from the fresh air plenum to "individual" outlets in the cockpit and cabin positioned in the ceiling above the seat. Air flow volume is controlled at each outlet. The direction of air flow is controlled by moving the oulet in its spherical socket.

(4) Stale air exhaust system. Stale air exhausted from the aircraft through an exhaust plenum in the cabin ceiling, and an exit air duct in the cabin floor when unlocked. The ceiling exhaust has no controls and routes cabin stale air to two exterior exit air ducts located on each side of the aft upper fuselage. The floor mounted exit air duct has a manually operated valve which is opened or closed by a lever placarded OPEN and CLOSED located just above the valve.

(5) Push-pull cockpit ventilation control. Push-pull type air inlet controls, placarded VENT AIR - PUSH ON, are located below the left and right subpanels and are manually adjustable to regulate cockpit ventilation (fig. 2-13, 2-14). When pushed IN, either control will cause outside air to flow from outlets above the respective rudder pedals. As a control is pulled out, there is a corresponding decrease in the amount of air flow.

(6) Push-pull cabin ventilation control. A push-pull type control, placarded CABIN AIR, PULL DECREASE, located on the right subpanel, manually controls ventilation of the cabin (fig. 2-13, 2-14). Airflow is at maximum when the control is pushed in. As the control is pulled out there is a corresponding decrease in the amount of air flow.

(7) Heater combustion unit. The heater is a combustion unit that uses the same fuel as the engines. The heater is located in the nose of the aircraft below the avionics compartment. The combustion blower operates on the ground whenever the heater control switch is in AUTO or MANUAL positions.

(8) Heater fuel pump. A heater fuel pump on the left wing spar operates whenever the HTR control switch is at MAN or AUTO. Fuel for the heater is obtained from the gravity feed fuel line between tanks (fig. 2-18). The cabin heater will continue to operate only until 28 gallons remain in the left wing tank, which is when fuel supply to the gravity feed line stops. If, at any time the combustion blower does not provide sufficient air to support combustion, a pressure differential switch, which compares pressure in the combustion chamber with static air pressure, will terminate heater operation. The pressure-differential switch will also terminate heater operation if the ventilation blower is inoperative or if ram air is insufficient.

(9) Pressure differential switch and duct temperature thermal switch. When either combustion blower air flow or vent blower air flow is insufficient, a differential pressure switch prevents heater operation. Also, to prevent heat damage to equipment located adjacent to a heater outlet, a duct temperature thermal switch allows the ventilation blower to continue operation on the ground after heater shutdown to purge heat from the system. This switch will shut off the ventilation blower when duct temperature is reduced to 52°C.

(10) Heater cycling switch. A cycling switch located in the hot air plenum disconnects power to the heater fuel solenoid valve at 107°C. If this automatic function should fail, temperature within the plenum will ultimately exceed 149°C and cause a 5-ampere fuse to blow, shutting down the heater. The 5-ampere fuse which is in series with the HTR control switch and the TEMP CONTROL circuit breaker, cannot be replaced in flight due to its location.

(11) Heater control switch. A switch (fig. 2-13, 2-14) placarded HTR MAN, OFF and AUTO, located on the right subpanel, controls heater operation. Either mode, AUTO or MAN, will activate the combustion air blower, the ventilation blower (if aircraft is on the ground), the heater fuel pump, open the fuel solenoid valve, and deliver power to the heater fuel line heater and igniter unit for combustion. After this switch is placed at AUTO or MAN, if temperature within the hot air plenum does not reach 52°C within a time-delay period, a CABIN HEAT OUT light (fig. 2-36, 2-37) will illuminate on the instrument panel. AUTO position of the heater control switch activates the heating system and couples it with a temperature-regulation circuit, which maintains the cockpit and cabin temperature between 18°C and 29°C, as established by the temperature control thermostat. MAN position activates the heating system, but cuts out the temperature-regulation circuit, allowing the heater to operate continuously until limit switches within the hot air plenum shut down the heater at either 107°C or 149°C. Following normal heater shutdown, by the heater control switch, a heater-actuated switch sustains combustion blower operation to purge the combustion chamber. When chamber temperature is dropped to 52°C, the switch opens to shut off the blower.

(12) Temperature control circuit breaker. The combustion blower, igniter, fuel pump, heater control box, and all sensing and regulating circuits are protected by a single 20-ampere circuit breaker, placarded TEMP CONTROL, located on the copilot's circuit breaker and fuse panel (fig. 2-29, 2-31).

(13) Cabin temperature rheostat. A rheostat, placarded CABIN TEMP, located on the right subpanel, controls the cockpit and cabin temperature between 18°C and 29°C in the AUTO mode of cabin heater operation (fig. 2-13, 2-14).

(14) Cabin heat out indicator light. A red, press-to-test CABIN HEAT OUT light on the RU-21A instrument panel (fig. 2-36) will illuminate when the HTR control switch is positioned to MAN or AUTO and the cabin heater is inoperative, or if cabin temperature is lower than 18°C.

b. Normal Operation – Cabin Heat.

NOTE

Operation with GPU is the same as operation with aircraft power.

1. Vent blower operation – Check.
2. HTR switch – AUTO.
3. CABIN TEMP control – As required.
4. CABIN AIR, VENT AIR, and DEFROST AIR controls – As required.

c. Emergency Operation – Cabin Heat. If the automatic temperature control should fail to operate, the temperature may be controlled manually by manipulating the HTR control switch between the OFF and MAN positions.

d. Normal Operation – Ventilation System.

1. HTR switch – OFF.
2. VENT BLOWER switch – ON.
3. Cold air outlets – Adjust as required.
4. CABIN AIR and VENT AIR controls – Position as required.

NOTE

With the heater control switch off, cold air will enter the cockpit and cabin through the warm air outlets.

NOTE

The two ventilation air blowers operate in nose avionics compartment only when the aircraft is on the ground with landing gear shock struts compressed by aircraft weight.

e. Flight Time Remaining at Cabin Heater Cutoff. Flight time and range capability of the aircraft are effected by combustion requirements of the cabin heater, using fuel from the same left wing storage system which feeds the left engine. However, as fuel level drops within the left wing tank to a near depletion quantity, a safety feature associated with gravity feed (fig. 2-21) stops the supply of fuel to the heater. This action reserves the final quantity for propulsion only. Available flight time following cabin heater cutoff will vary due to the interaction of several factors. One factor is pilot technique in fuel management and others are associated with the operation of automatic components of the fuel system. This chapter will describe features of the fuel system which establish the amount of fuel reserve "on hand" at the time of cabin heater cutoff. Coverage will also include a technique of fuel management by which the pilot may shorten the terminal period of flight after cabin heater cutoff, to maintain a maximum comfort period for occupants, although with some penalty to total range capability.

NOTE

The heater and defroster will be inoperative when the left wing tanks have less than 28 gallons remaining.

f. Fuel Management Techniques Affecting Flight Time After Heater Cutoff. It is within the pilot's perogative to shorten the time of flight which must be endured without heater operation. Flight time after heater cutoff can be decreased up to 50% by cross feeding from the right wing tanks to the left engine previous to heater cutoff. It is then possible to have all remaining wing fuel in the left wing tanks when the cabin heater stops. This should be accomplished as follows: When the remaining fuel within the left wing tanks is lowered to approximately one-quarter of gage capacity measure, commence crossfeed operation from the right wing fuel system. Continue feeding both engines from the right wing fuel system until the NO TRANSFER warning light is illuminated on the annunciator panel. At this point, there are between 8 and 24 gallons of fuel left in the right nacelle tank. Both engines may now be fed from the left wing fuel system. Total range capability of the aircraft is reduced by this fuel management technique.

g. Mission Console Cooling **RU-21A** Each mission console has an individual cooling system. The forward console receives cooling air from the cabin interior and exits the cooling air from a backward-facing exhaust outlet above the console on the fuselage exterior. The aft mission console obtains cooling air from a forward-facing air scoop and exits this air from an aft facing exhaust outlet. The scoop and exhaust vent are both mounted above the console on the fuselage exterior.

Section IX. ELECTRICAL POWER SUPPLY AND DISTRIBUTION SYSTEM

2-74. Description. RU-21A

This aircraft employs both direct current (DC) and alternating current (AC) electrical power (fig. 2-29 and 2-30). The DC electrical supply forms the basic power system, energizing most aircraft circuits. AC power is obtained from DC power through inverters. The three sources of DC power consist of one 24-volt, 34-ampere/hour battery and two 250-ampere starter-generators. Starter-generators are controlled by soild state regulators. The output of each generator passes through a cable to the respective generator bus. Other buses distribute power to aircraft DC loads, and derive power from the generator buses. When the generator buses are coupled, the generators may be paralleled to balance DC loads between the two units. When the generating systems are not coupled, only generator paralleling and load balance between the two units is lost. In this circumstance, all aircraft DC loads continue to be supplied from one or the other generating source, but not from both. Most DC distribution buses are connected to both generator buses but have isolation diodes to prevent power crossfeed between the generating systems, when connection between the generator buses is uncoupled. Thus, when either is shut down, the other operating unit can supply power for all aircraft DC loads except those receiving power from the inoperative generator's buses which cannot be crossfed. When a generator is not operating, reverse current and over-voltage protection is automatically provided. Two inverters operating from DC power produce the required single-phase AC power and one of these, a standby unit, will also produce 3-phase AC, when selected. A third inverter unit, operating from DC power, produces 3-phase AC only. The INS voltage regulator receives DC power from the battery, aircraft generators, or GPU which it regulates and delivers to the INS. The INS voltage regulator functions continuously on the ground or in flight whenever power is applied to either generator bus. Bus isolation excludes the battery from engine starting loads to prevent a large voltage drop to the INS voltage regulator. Battery charge is thus conserved and is used to supply essential voltage to the INS voltage regulator. Bus isolation is used only during engine starts. Bus isolation restricts current from the ground power unit (GPU) to starter circuits only and prevents GPU voltage spikes from entering the INS voltage regulator. Bus isolation is controlled by the BUS ISO switch on the left subpanel. Except for the starter circuits, battery power remains applied to all aircraft buses during the use of bus isolation.

2-75. DC Power Supply. RU-21A

One nickel-cadmium battery furnishes DC power when the engines are not operating. It is a 24-volt, 34-ampere/hour battery located in the right wing center section, and is accessible through a panel on the top of the wing. Generated DC power is produced by two engine-driven 28-volt 250-ampere starter-generators. Controls and indicators for the DC power system are located on the left subpanel, and consist of a battery switch (BAT), two generator switches (GEN 1 and GEN 2), a MASTER SWITCH bar and two volt-loadmeters.

a. Battery Switch. A switch, placarded BAT is located on the left subpanel under the MASTER SWITCH bar (fig. 2-13). This switch controls application of DC power to the bus system through the battery relay, and must be ON (up) for external power to enter aircraft circuits. When the MASTER SWITCH bar is placed down, the BAT switch is forced OFF (BAT).

b. Bus Isolation Switch. A two-position switch, placarded BUS ISO, OFF, is located on the left subpanel (fig. 2-13). This switch can restrict GPU power to engine start circuits only, to prevent battery voltage drop due to the starting load, and to isolate GPU voltage spikes from the INS system. When a GPU is connected, if the BUS ISO switch is OFF, and the BAT switch is ON (up) - battery and GPU power are both applied to the starter relays and generator buses. When the switch is in BUS ISO (on) position, with the BAT switch ON, GPU power is applied to the starter relays only, and the battery alone supplies power to other electrical loads. A low battery may be charged by placing the BAT switch ON (up), and the BUS ISO switch OFF.

c. Generator Switches. Two switches, placarded GEN 1 and GEN 2 are located on the left subpanel under the MASTER SWITCH bar (fig. 2-13). These switches control electrical power from the designated generators to paralleling circuits and the bus distribution system. Switch positions are not placarded - however (up) is ON and GEN (down) is OFF. If a generator's output is removed from the electrical system, due to a temporary fault or placement of the GEN switch in OFF (GEN) position, placing the GEN switch in ON position (up) will restore power to aircraft circuits from the respective generator.

d. Master Switch. All electrical current may be shut off using the MASTER SWITCH bar (fig. 2-13) which extends above the battery and generator

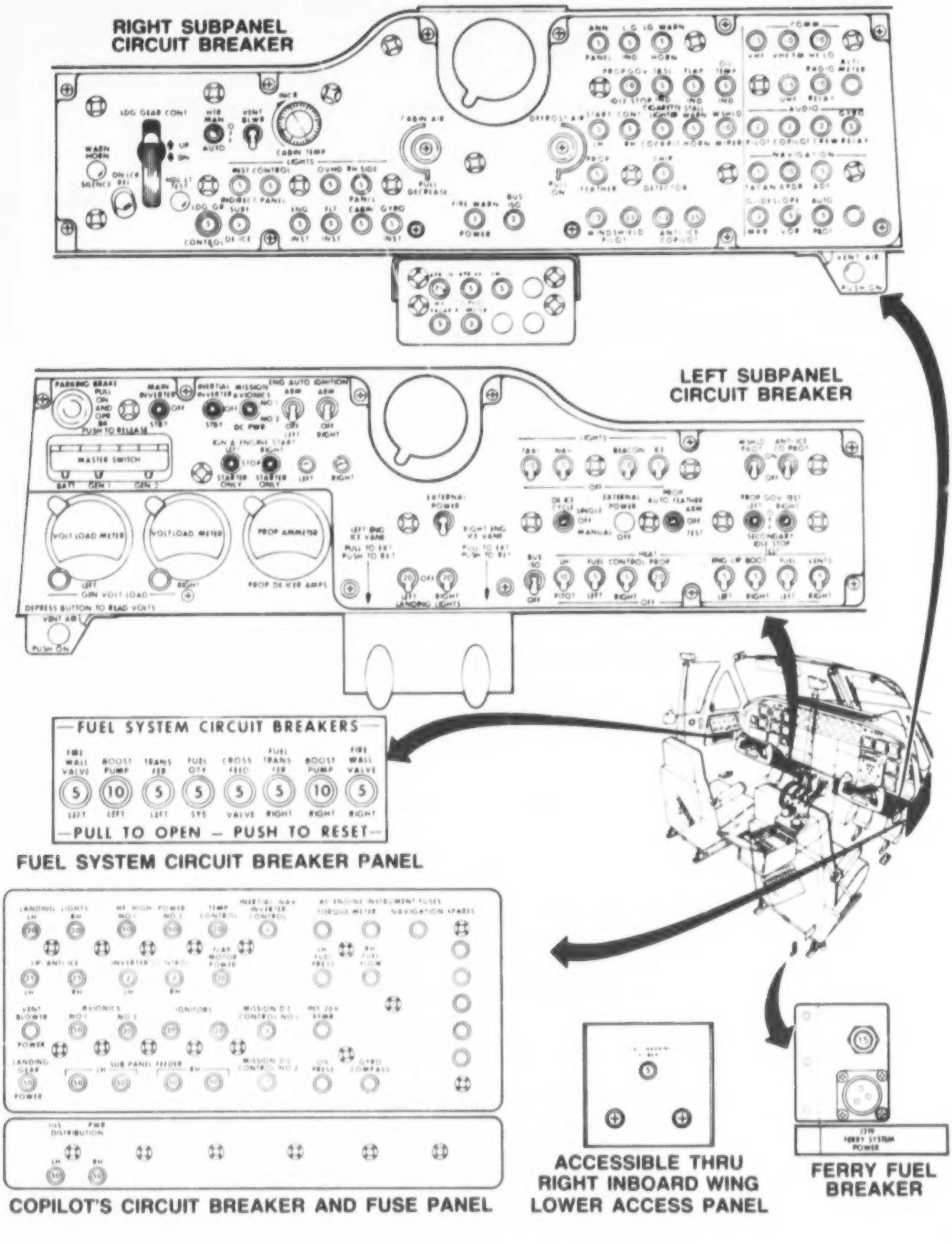
RIGHT SUBPANEL CIRCUIT BREAKER
LEFT SUBPANEL CIRCUIT BREAKER
FUEL SYSTEM CIRCUIT BREAKERS
FIRE WALL VALVE
BOOST PUMP
TRANS FER
FUEL QTY
CROSS FEED
FUEL TRANS FER
BOOST PUMP
FIRE WALL VALVE
5
10
5
5
5
5
10
5
LEFT
LEFT
LEFT
SYS
VALVE
RIGHT
RIGHT
RIGHT
PULL TO OPEN – PUSH TO RESET
FUEL SYSTEM CIRCUIT BREAKER PANEL
MASTER SWITCH
VOLT LOAD METER
VOLT LOAD METER
PROP AMMETER
COPILOT'S CIRCUIT BREAKER AND FUSE PANEL
ACCESSIBLE THRU RIGHT INBOARD WING LOWER ACCESS PANEL
FERRY FUEL BREAKER

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Figure 2-29. Circuit Breaker and Fuse Panels **RU-21A**

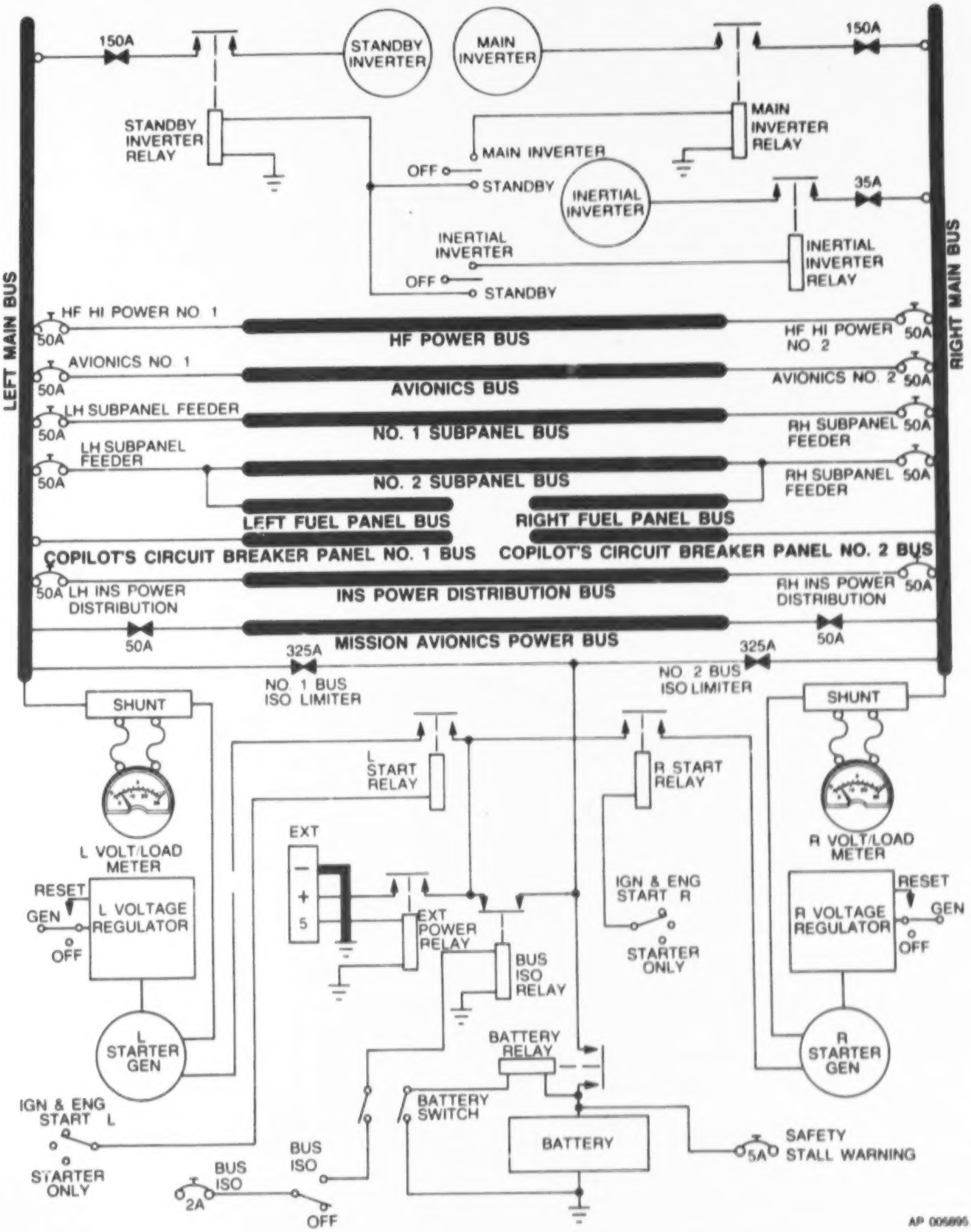
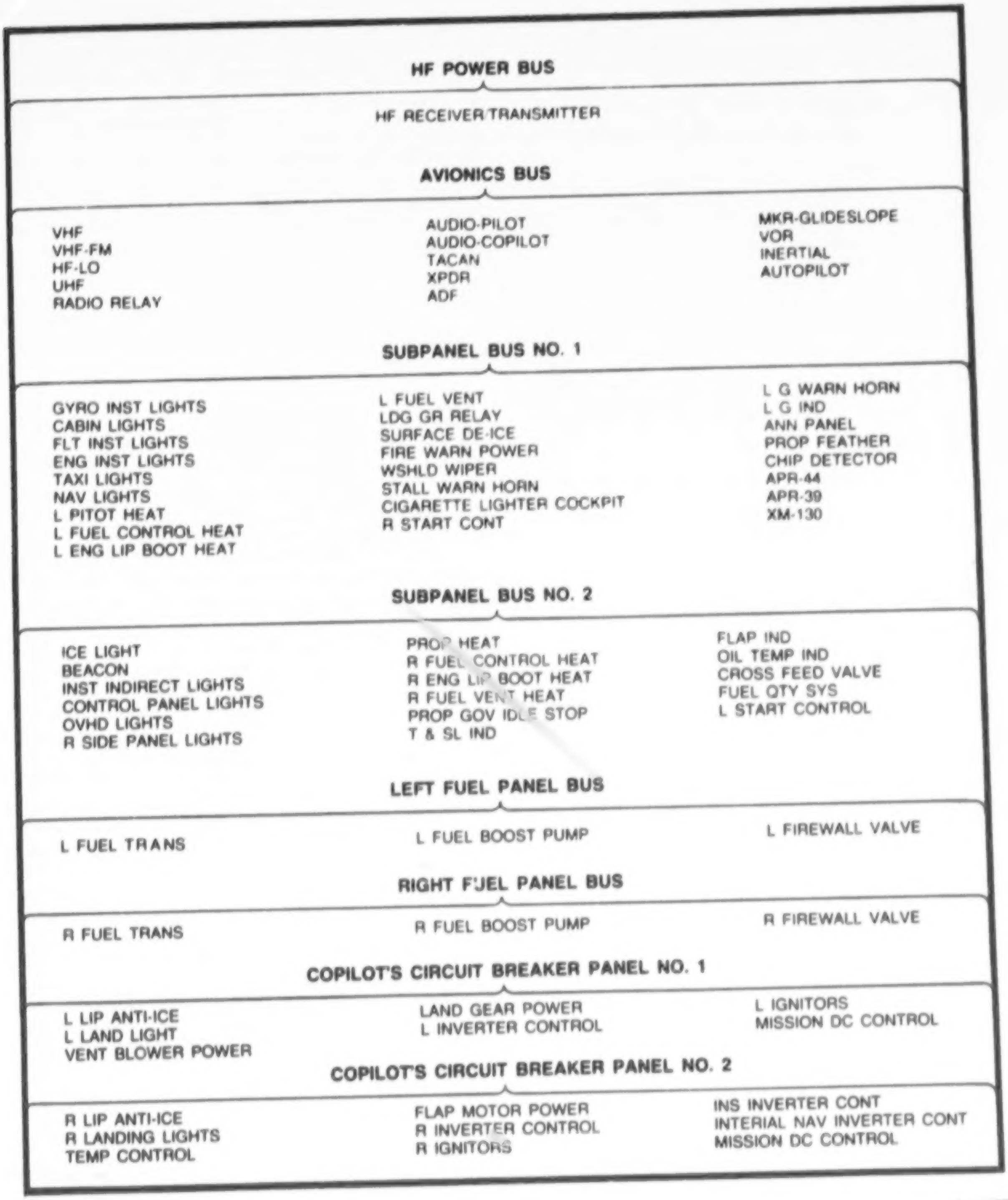


Figure 2-30. Electrical System Schematic RU-21A (Sheet 1 of 3)



HF POWER BUS

HF RECEIVER/TRANSMITTER

AVIONICS BUS

VHF
VHF-FM
HF-LO
UHF
RADIO RELAY

AUDIO-PILOT
AUDIO-COPILOT
TACAN
XPDR
ADF

MKR-GLIDESLOPE
VOR
INERTIAL
AUTOPILOT

SUBPANEL BUS NO. 1

GYRO INST LIGHTS
CABIN LIGHTS
FLT INST LIGHTS
ENG INST LIGHTS
TAXI LIGHTS
NAV LIGHTS
L PITOT HEAT
L FUEL CONTROL HEAT
L ENG LIP BOOT HEAT

L FUEL VENT
LDG GR RELAY
SURFACE DE-ICE
FIRE WARN POWER
WSHLD WIPER
STALL WARN HORN
CIGARETTE LIGHTER COCKPIT
R START CONT

L G WARN HORN
L G IND
ANN PANEL
PROP FEATHER
CHIP DETECTOR
APR-44
APR-39
XM-130

SUBPANEL BUS NO. 2

ICE LIGHT
BEACON
INST INDIRECT LIGHTS
CONTROL PANEL LIGHTS
OVHD LIGHTS
R SIDE PANEL LIGHTS

PROP HEAT
R FUEL CONTROL HEAT
R ENG LIP BOOT HEAT
R FUEL VENT HEAT
PROP GOV IDLE STOP
T & SL IND

FLAP IND
OIL TEMP IND
CROSS FEED VALVE
FUEL QTY SYS
L START CONTROL

LEFT FUEL PANEL BUS

L FUEL TRANS

L FUEL BOOST PUMP

L FIREWALL VALVE

RIGHT FUEL PANEL BUS

R FUEL TRANS

R FUEL BOOST PUMP

R FIREWALL VALVE

COPILOT'S CIRCUIT BREAKER PANEL NO. 1

L LIP ANTI-ICE
L LAND LIGHT
VENT BLOWER POWER

LAND GEAR POWER
L INVERTER CONTROL

L IGNITORS
MISSION DC CONTROL

COPILOT'S CIRCUIT BREAKER PANEL NO. 2

R LIP ANTI-ICE
R LANDING LIGHTS
TEMP CONTROL

FLAP MOTOR POWER
R INVERTER CONTROL
R IGNITORS

INS INVERTER CONT
INTERIAL NAV INVERTER CONT
MISSION DC CONTROL

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Figure 2-30. Electrical Schematic **RU-21A** *(Sheet 2 of 3)*

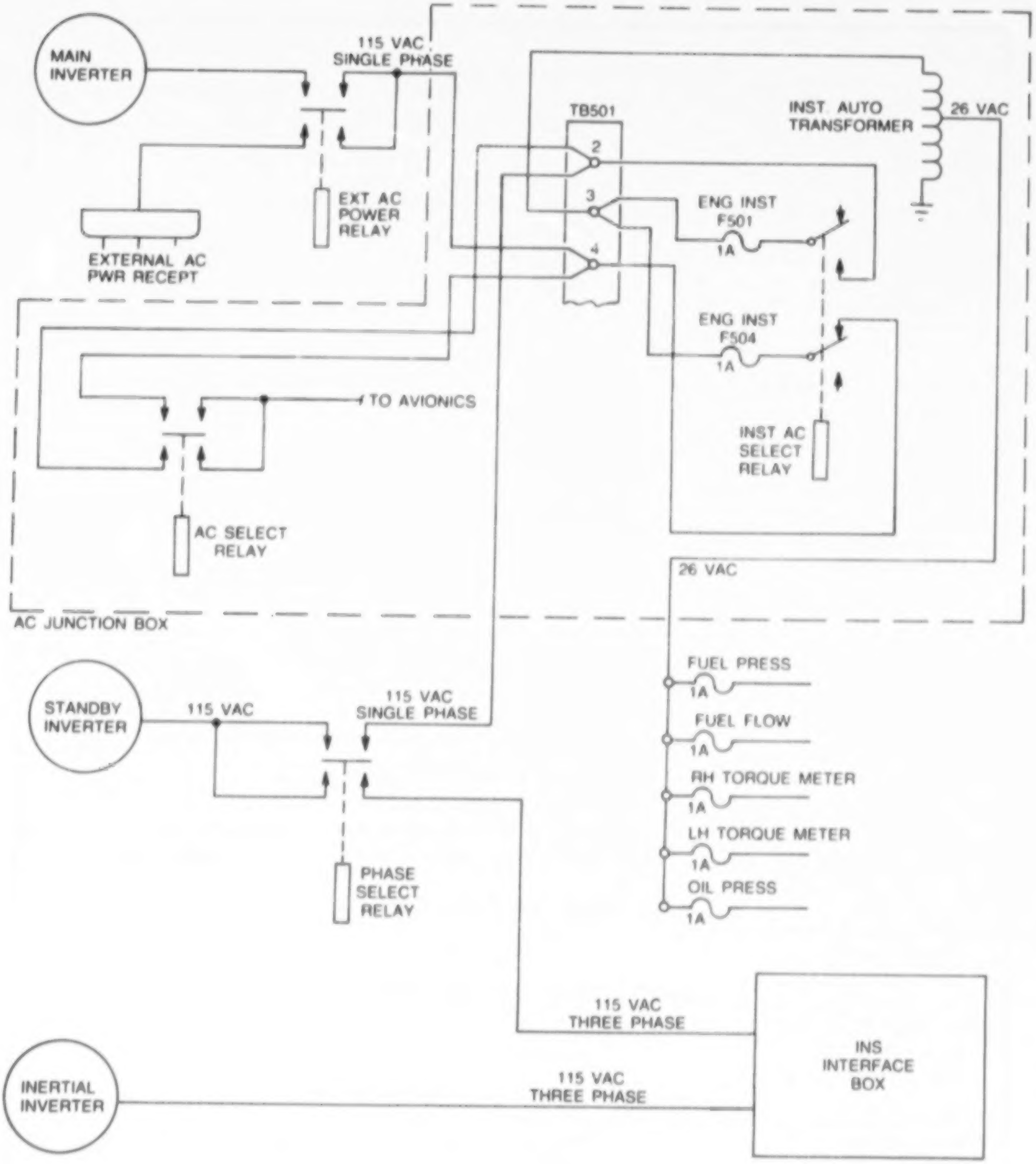


Figure 2-30. Electrical Schematic **RU-21A** *(Sheet 3 of 3)*

switches. The MASTER SWITCH bar is raised when a battery or generator switch is turned on. Placed down, the bar forces each switch to the OFF position.

e. Volt-loadmeters. Two meters on the left subpanel display voltage readings and show the electrical load from left and right generating systems (fig. 2-13). Each meter is equipped with a spring-loaded push-button switch which when manually pressed will cause the meter to indicate main bus voltage. Each meter normally shows output electrical load from the respective generator, unless the push-button switch is pressed to obtain bus voltage reading. Current consumption is indicated as a percentage of total output amperage capacity for the generating system monitored.

f. Battery Monitor. Nickel-cadmium battery overheating will cause the battery charge current to increase. The aircraft has a charge-current sensor which will detect a charge current. The charge current system senses battery current through a shunt in the negative lead of the battery. Any time the battery charging current exceeds approximately 7-amperes for 6 seconds or longer, the yellow BATTERY CHARGE annunciator light and the master fault caution light will illuminate. Following a battery engine start, the caution light will illuminate approximately six seconds after the generator switch is placed in the ON position. The light will normally extinguish within two to five minutes, indicating that the battery is approaching a full charge. The time interval will increase if the battery has a low state of charge, the battery temperature is very low, or if the battery has previously been discharged at a very low rate (i.e., battery operation of radios or lights for prolonged periods). The caution light may also illuminate for short intervals after landing gear and/or flap operation. If the caution light should illuminate during normal steady-state cruise, it indicates that conditions exist that may cause a battery thermal runaway. If this occurs, the battery switch shall be turned OFF and may be turned back ON only for gear and flap extension and approach to landing.

NOTE

Battery may be usable after a 15 to 20 minute cool down period.

g. Generator Out Warning Lights. Two annunciator panel fault lights inform the pilot when either generator is not delivering current to the aircraft DC bus system. These lights are placarded LH GEN OUT and RH GEN OUT (fig. 2-36). A flashing FAULT WARN light and illumination of either fault light indicates that either the identified generator has failed or voltage is insufficient to keep it connected to the bus distribution system.

h. DC External Power Source. External DC power can be applied to the aircraft through an external power receptacle on the underside of the right wing leading edge just outboard of the engine nacelle (fig. 2-38). The receptacle is installed inside of the wing structure and is accessible through a hinged access panel. DC power is supplied through the DC external plug and applied directly to the battery bus after passing through the external power relay. The holding coil circuit of the relay is energized by the external power source.

2-76. AC Power Supply. RU-21A

AC power for the aircraft is supplied by three inverter units, which obtain operating current from the DC power system. Two inverters, rated at 2500 volt-amperes, are identified as MAIN and STBY. The MAIN inverter provides single-phase output only. The STBY inverter produces either single-phase (aircraft) or three-phase (INS) output. The INERTIAL INVERTER rated at 750 volt-amperes, provides three-phase output only. The heaters of the INS and the gyros in the inertial platform have the only aircraft requirement for three-phase AC. Aircraft equipment operating from single-phase AC include the following: pilot's attitude indicator, the tuning portion of the ADF receiver, gyro magnetic compass, transmitter portion of the HF receiver, RMI, weather radar, engine instruments for oil pressure, fuel flow and torquemeters. Controls and indicators of the AC power system are in the cockpit, located on the main instrument panel, the annunciator panel, and on the left subpanel. The pilot selects AC sources using the two inverter select switches located on the left subpanel.

a. AC Power Warning Lights. The loss of AC power is indicated on the Annunciator panel by continously illuminated fault lights: MAIN INV OUT, INS INV OUT and STANDBY INV OUT (fig. 2-36).

b. Inverter Control Switches. Two switches, placarded MAIN INVERTER and INERTIAL INVERTER, on the left subpanel give the pilot a choice of inverters to provide single-phase and three-phase AC power (fig. 2-13). Three inverters are involved in this selection.

NOTE

When inverters are switched the magnetic compass will be affected.

(1) *Main inverter switch.* The switch placarded MAIN INVERTER, OFF, and STBY provides a choice between two 2500 volt-ampere units for single-phase power. In the MAIN INVERTER (up) position, the unit selected is capable of single-phase output only, and is intended to provide single-phase power during normal flight operation. STBY position activates the alternate inverter for emergency single-phase power.

NOTE

When the MAIN INVERTER switch is OFF, the aircraft is deprived of all inverter-generated single-phase power regardless of the position of the INERTIAL INVERTER switch.

(2) *INS inverter switch.* The INS inverter switch placarded INERTIAL INVERTER, OFF, and STBY, selects three-phase power from the INS inverter rated at 750 volt-amperes, or the STBY larger inverter rated at 2500 volt-amperes. With the switch in the INERTIAL INVERTER (up) position, either the INERTIAL or STBY inverter, or both, will operate as determined by automatic select circuitry, and the position of the INS mode switch. If the INS mode switch is OFF, STBY, or ALIGN position, the STBY inverter will be energized. When the INS mode switch is in the NAV or AD (air data) position, the INERTIAL INVERTER will be energized. With the switch in the STBY (down) position, only the STBY inverter will operate.

NOTE

If the INERTIAL INVERTER is selected, and the MAIN INVERTER switch is in STBY position, the standby inverter will give power to the aircraft's systems and the INERTIAL INVERTER will come on automatically for INS operation.

NOTE

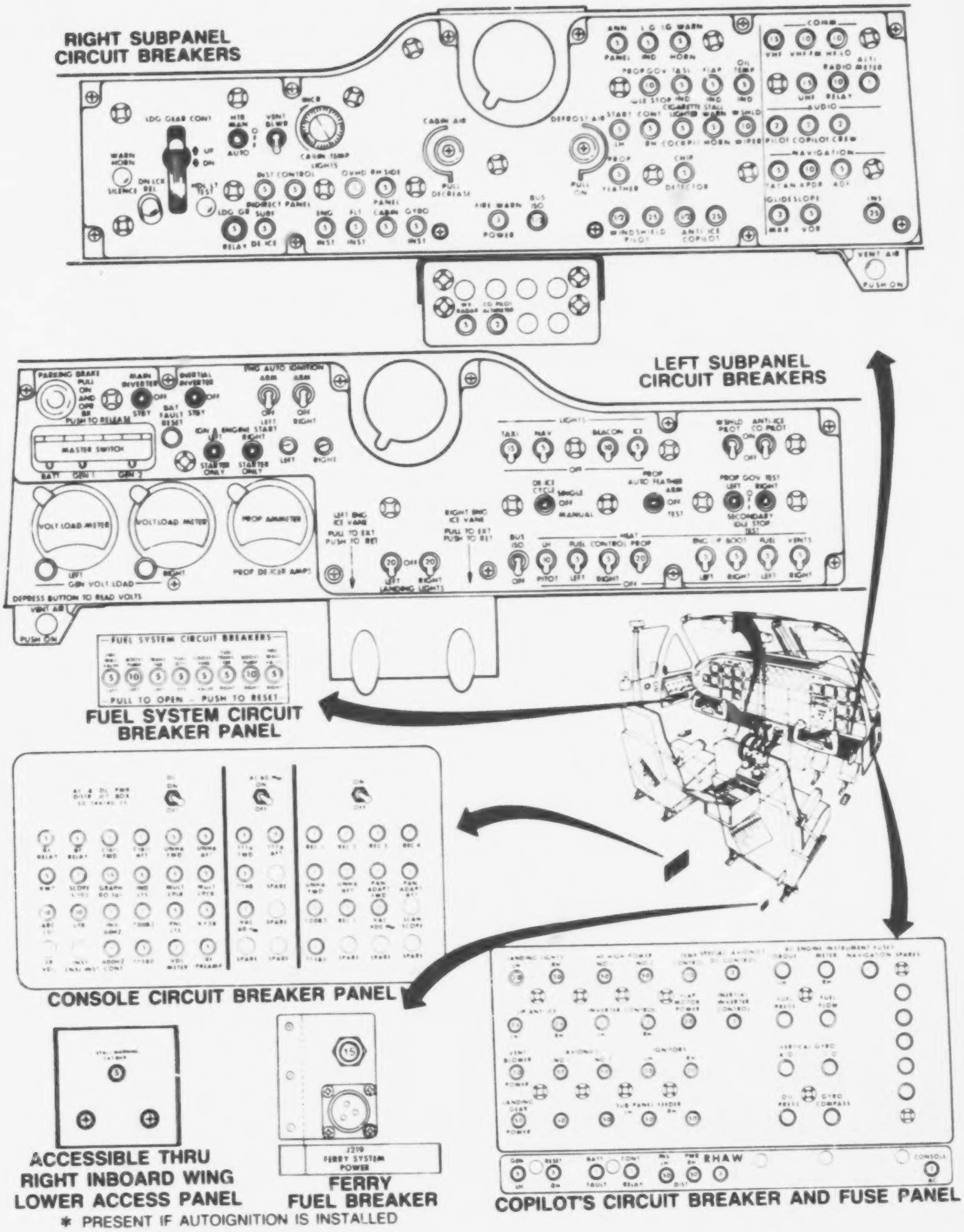
When the INERTIAL INVERTER switch is OFF, the aircraft is deprived of all three-phase power, regardless of the position of the MAIN INVERTER switch.

c. Inverter Control Circuit Breakers. Inverter control relay circuits are protected by 2-ampere circuit breakers on the copilot's circuit breaker and fuse panel. They are placarded INERTIAL NAV INVERTER CONTROL (fig. 2-31). Added protection consists of a current limiter capable of stopping DC flow to the power relay.

d. AC External Power Sources. Single-phase AC power may be applied to the aircraft through an external power receptacle on the underside of the left wing leading edge just outboard of the engine nacelle (fig. 2-38). The receptacle is installed inside of the wing structure and is accessible through a hinged access panel. An EXTERNAL POWER, OFF switch, on the left subpanel permits selection between two sources for single-phase AC power (fig. 2-13). OFF position admits only aircraft inverter power into the distribution circuits. At EXTERNAL POWER position, if the BAT switch is ON, the output of aircraft inverters is excluded from aircraft circuits and only single-phase AC power delivered through the external power receptacle may enter aircraft circuits. During normal operation of the aircraft this switch should be in the OFF position.

2-77. Description RU-21D

This aircraft employs both direct current (DC) and alternating current (AC) electrical power (fig. 2-31, 2-32). The DC electrical supply forms the basic power system, energizing most aircraft circuits. AC power is obtained from DC power through inverters. The three sources of DC power consist of one 24-volt, 40 ampere/hour battery and two 300-ampere starter-generators. Starter-generators are controlled by generator control units. The output of each generator passes through a cable to the respective generator bus. Other buses distribute power to aircraft DC loads, and derive power from the generator buses. When the generator buses are coupled, the generators may be paralleled to balance DC loads between the two units. When the generating systems are not coupled, if no fault exists, only generator paralleling and load balance between the two units is lost. In this circumstance, all aircraft DC loads continue to be supplied from one or the other generating source, but not from both. Most DC distribution buses are connected to both generator buses but have isolation diodes to prevent power crossfeed between the generating systems, when connection between the generator buses is uncoupled. Thus, when either generator is shut down, the other operating unit can supply power for all aircraft DC loads except those receiving power from the inoperative generator's bus which cannot be crossfed. When a generator is



✱ PRESENT IF AUTOIGNITION IS INSTALLED

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Figure 2-31. Circuit Breaker and Fuse Panels **RU-21D**

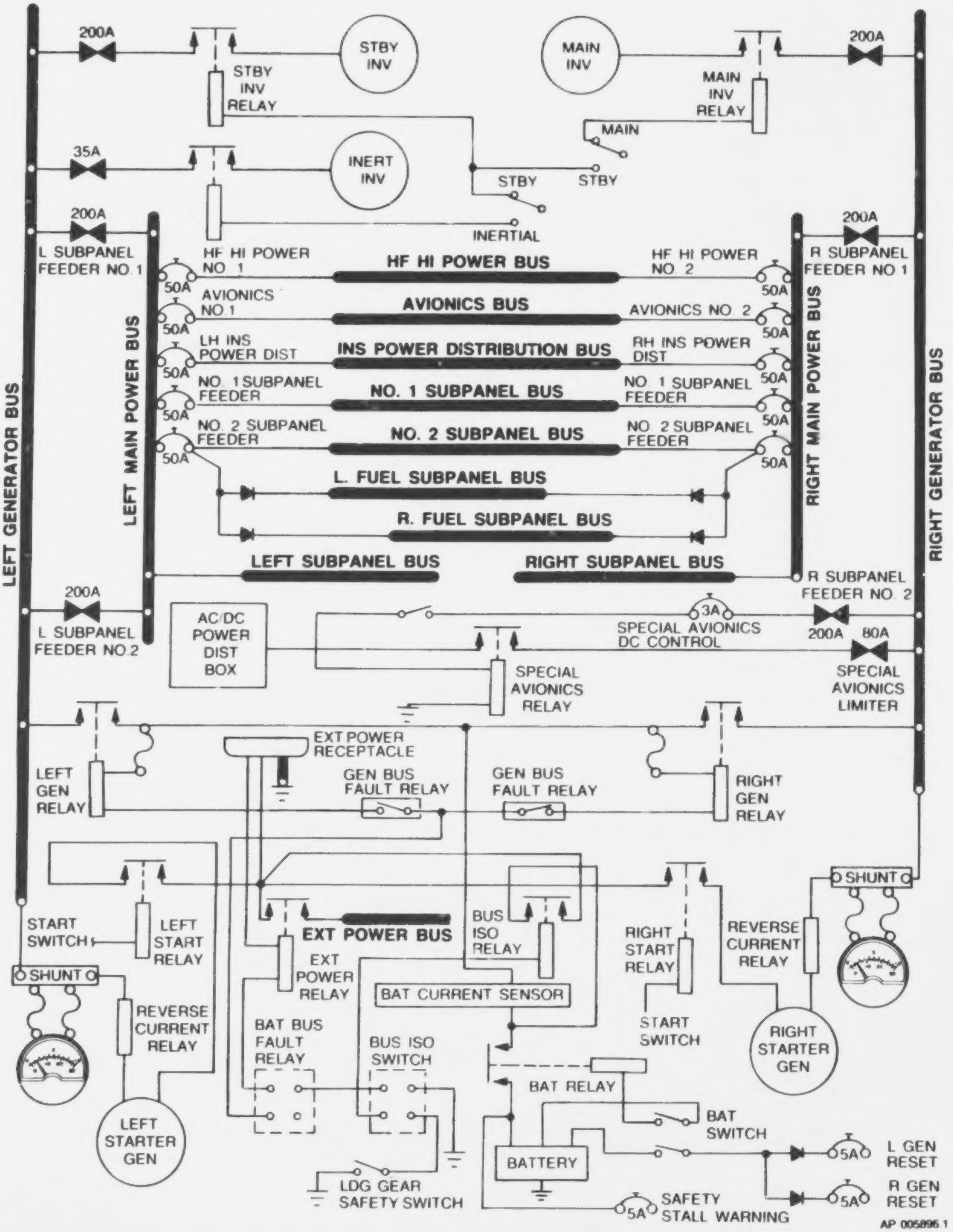

Figure 2-32. Electrical System Schematic **RU-21D** (Sheet 1 of 3)

HF HI POWER BUS

HF RECEIVER-TRANSMITTER

AVIONICS BUS

VHF
VHF-FM
HF-LO
UHF
RADIO RELAY
AUDIO-PILOT
AUDIO-COPILOT
TACAN
XPDR
ADF
MKR-GLIDESLOPE
VOR
INS

INS PWR DISTRIBUTION BUS

INERTIAL NAVIGATION SYSTEM

NO. 1 SUBPANEL BUS

GYRO INST LIGHTS
CABIN LIGHTS
FLT INST LIGHTS
ENGINE INST LIGHTS
TAXI LIGHTS
NAV LIGHTS
L PITOT HEAT
L FUEL CONTROL HEAT
R FUEL CONTROL HEAT
L FUEL VENT
LANDING GEAR RELAY
SURFACE DE-ICE
FIRE WARN POWER
WINDSHIELD WIPER
STALL WARN HORN
CIGARETTE LIGHTER COCKPIT
R STARTER CONTROL
L G WARN HORN
LG INDICATOR
ANNUNCIATOR PANEL
PROP FEATHER
CHIP DETECTOR
APR - 44
APR - 39
XM - 130

NO. 2 SUBPANEL BUS

ICE LIGHT
BEACON
INST INDIRECT LIGHTS
CONTROL PANEL LIGHTS
OVHD LIGHTS
R SIDE PANEL LIGHTS
PROP HEAT
R FUEL CONTROL HEAT
R ENG LIP BOOT HEAT
R FUEL VENT HEAT
PROP GOV IDLE STOP
T & SL INDICATOR
FLAP INDICATOR
OIL TEMP INDICATOR
CROSSFEED VALVE
FUEL QYT SYSTEM
L STARTER CONTROL
BATTERY FAULT
BATTERY RELAY

L FUEL SUBPANEL BUS

L FUEL TRANSFER
L FUEL BOOST PUMP
L FIREWALL VALVE

R FUEL SUBPANEL BUS

R FUEL TRANSFER
R FUEL BOOST PUMP
R FIREWALL VALVE

LEFT SUBPANEL BUS

L LIP ANTI-ICE
L LANDING LIGHTS
VENT BLOWER POWER
LANDING GEAR POWER
L IGNITORS
MAIN INVERTER CONTROL
INITIAL INVERTER CONTROL

RIGHT SUBPANEL BUS

R LIP ANTI-ICE
R LANDING LIGHTS
TEMP CONTROL
FLAP MOTOR POWER
R IGNITORS
STANDBY INVERTER CONTROL
SPECIAL AVIONICS CONTROL

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Figure 2-32. Electrical System Schematic **RU-21D** *(Sheet 2 of 3)*

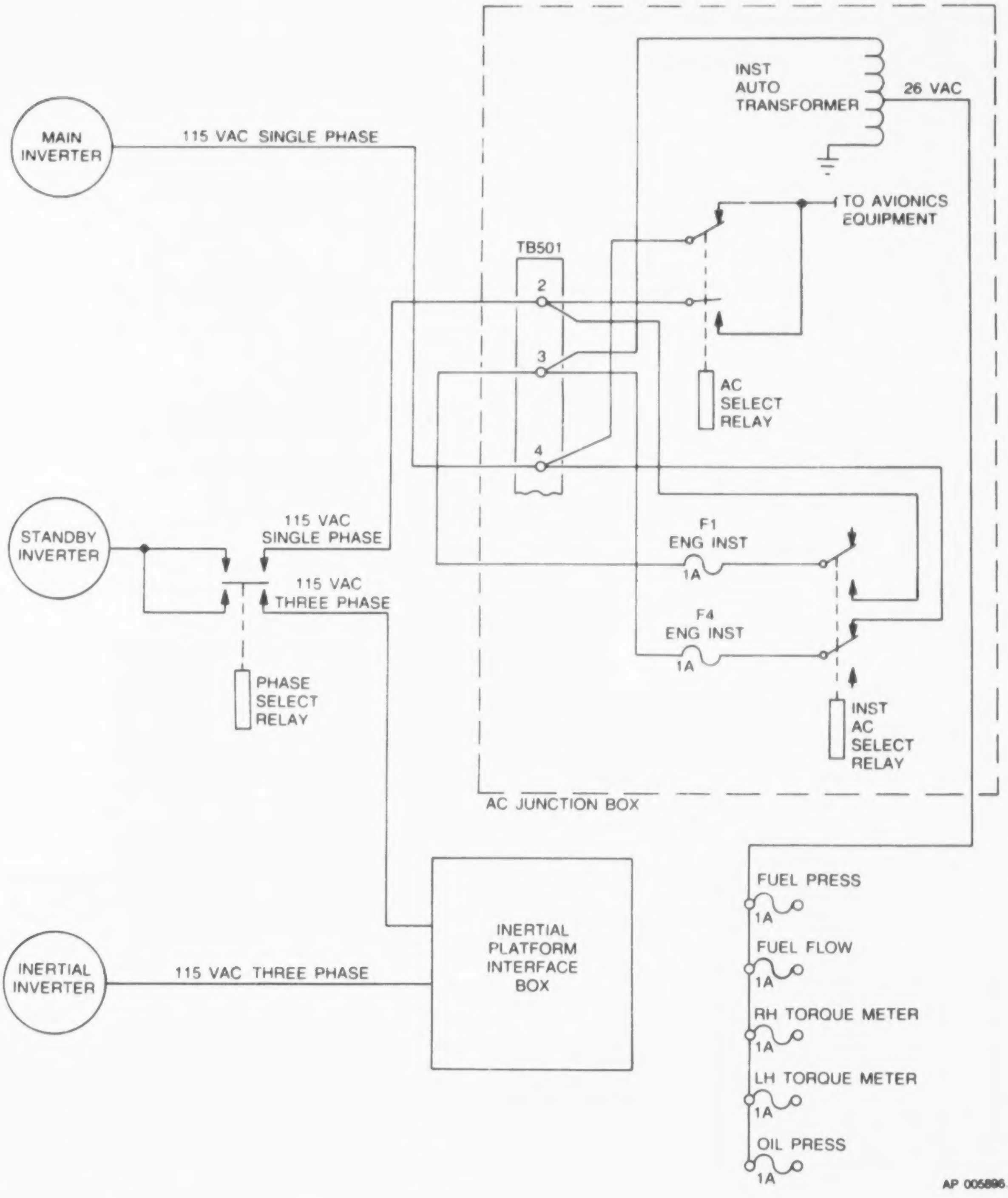


Figure 2-32. Electrical System Schematic **RU-21D** *(Sheet 3 of 3)*

not operating, reverse current and over-voltage protection is automatically provided. Two inverters operating from DC power produce the required single-phase AC power, and one of these, a standby unit, will also produce 3-phase AC, when selected. A third inverter unit, operating from DC power, produced 3-phase AC only. The constant-voltage power supply (CVS) receives DC power from the battery, aircraft generators, or GPU which it regulates and delivers to the INS. The CVS unit functions continuously on the ground or in flight whenever power is applied to either generator bus. Bus isolation excludes the battery from engine starting loads to prevent a large voltage drop to the CVS unit. Battery charge is thus conserved and is used to supply essential voltage to the INS voltage regulator. Bus isolation is used only during engine starts. Bus isolation restricts current from the ground power unit (GPU) to starter circuits only and prevents GPU voltage spikes from entering the CVS unit. Bus isolation is controlled by the BUS ISO switch on the left subpanel. Except for the starter circuits, battery power remains applied to the all aircraft buses during the use of isolation.

2-78. DC Power Supply. RU-21D

One nickel-cadmium battery furnishes DC power when the engines are not operating. It is a 24-volt, 40-ampere/hour battery located in the right wing center section, and is accessible through a panel on the top of the wing. Generated DC power is produced by two engine-driven 28-volt 300-ampere starter-generators. Controls and indicators for the DC power system are located on the left subpanel, and consist of a battery switch (BAT), two generator switches (GEN 1 and GEN 2), a MASTER SWITCH bar and two volt-loadmeters.

a. Battery Switch. A switch, placarded BAT, is located on the left subpanel under the MASTER SWITCH bar (fig. 2-14). This switch controls application of DC power to the bus system through the battery relay, and must be ON (up) for external power to enter aircraft circuits. When the MASTER SWITCH bar is placed down, the BAT switch is forced OFF (BAT).

b. Bus Isolation Switch. A two-position switch, placarded BUS ISO, OFF, is located on the left subpanel (fig. 2-14). This switch can restrict GPU power to engine start circuits only, to prevent battery voltage drop due to the starting load, and to isolate GPU voltage spikes from the INS system. When a GPU is connected, if the BUS ISO switch is OFF, and the BAT switch is ON (up), battery and GPU power are both applied to the starter relays and generator buses. When the switch is in BUS ISO (on) position, with the BAT switch ON, GPU power is applied to the starter relays only, and the battery alone supplies power to other electrical loads. A low battery may be charged by placing the BAT switch ON (up), and the BUS ISO switch OFF.

c. Generator Switches. Two switches, placarded GEN 1 and GEN 2, are located on the left subpanel under the MASTER SWITCH bar (fig. 2-14). These switches control electrical power from the designated generators to paralleling circuits and the bus distribution system. Switch positions REST, ON and OFF are placarded only on the MASTER SWITCH bar. RESET is "up" (spring-loaded back to ON). ON is "center", and OFF is "down". When a generator's output is removed from aircraft circuits, due to a fault condition or to placing the GEN switch in OFF position, output from the affected unit cannot be restored to aircraft use until the respective GEN switch is first moved to RESET position, then to ON.

d. Master Switch. All electrical current may be shut off using the MASTER SWITCH bar (fig. 2-14) which extends above the battery and generator switches. The MASTER SWITCH bar is raised when a battery or generator switch is turned on. Placed down, the bar forces each switch to the OFF position.

e. Volt-loadmeters. Two meters on the left subpanel display voltage readings and show the rate of current usage from left and right generating systems (fig. 2-14). Each meter is equipped with a spring-loaded push-button switch which when manually pressed will cause the meter to indicate main bus voltage. Each meter normally shows output amperage reading from the respective generator, unless the push-button switch is pressed to obtain bus voltage reading. Current consumption is indicated as a percentage of total output amperage capacity for the generating system monitored.

f. Battery Monitor. Nickel-cadmium battery overheating will cause the battery charge current to increase if thermal runaway is imminent. The aircraft has a charge-current sensor which will detect a charge current. The charge current system senses battery current through a shunt in the negative lead of the battery. Any time the battery charging current exceeds approximately 7-amperes for 6 seconds or longer, the yellow BATTERY

CHARGE annunciator light and the master fault caution light will illuminate. Following a battery engine start, the caution light will illuminate approximately six seconds after the generator switch is placed in the ON position. The light will normally extinguish within two to five minutes, indicating that the battery is approaching a full charge. The time interval will increase if the battery has a low state of charge, the battery temperature is very low, or if the battery has previously been discharged at a very low rate (i.e., battery operation of radios or lights for prolonged periods). The caution light may also illuminate for short intervals after landing gear and/or flap operation. If the caution light should illuminate during normal steady-state cruise, it indicates that conditions exist that may cause a battery thermal runaway. If this occurs, the battery switch shall be turned OFF and may be turned back ON only for gear and flap extension and approach to landing.

NOTE

Battery may be usable after a 15 to 20 minute cool down period.

g. Generator Out Warning Lights. Two annunciator panel fault lights inform the pilot when either generator is not delivering current to the aircraft DC bus system. These lights are placarded LH GEN OUT and RH GEN OUT (fig. 2-36). A flashing FAULT WARN light and illumination of either fault light indicates that either the identified generator has failed or voltage is insufficient to keep it connected to the bus distribution system.

CAUTION

The GPU shall be adjusted to regulate at 28 volts maximum to prevent damage to the aircraft battery.

h. DC External Power Source. External DC power can be applied to the aircraft through an external power receptacle on the underside of the right wing leading edge just outboard of the engine nacelle (fig. 2-38). The receptacle is installed inside of the wing structure and is accessible through a hinged access panel. DC power is supplied through the DC external plug and applied directly to the battery bus after passing through the external power relay. The holding coil circuit of the relay is energized by the external power source.

2-79. AC Power Supply. RU-21D

AC power for the aircraft is supplied by three inverter units, which obtain operating current from the DC power system. Two inverters, rated at 2500 volt-amperes, are identified as MAIN and STBY. The MAIN inverter provides single-phase output only. The STBY inverter produces either single-phase (aircraft) or three-phase (INS) output. The INERTIAL INVERTER rated at 750 volt-amperes, provides three-phase output only. The heaters of the INS and the gyros in the inertial platform have the only aircraft requirement for three-phase AC. Aircraft equipment operating from single-phase AC include the following: pilot's attitude indicator, the turning portion of the ADF receiver, gyro magnetic compass, transmitter portion of the HF receiver, RMI, weather radar, engine instruments for oil pressure, fuel flow and torquemeters. Controls and indicators of the AC power system are in the cockpit, located on the main instrument panel, the annunciator panel, and on the left subpanel. The pilot selects AC sources using the two inverter select switches located on the left subpanel.

a. AC Power Warning Lights. The loss of AC power is indicated on the Annunciator panel by continously illuminated fault lights: MAIN INV OUT, INS INV OUT and STANDBY INV OUT (fig. 2-39).

b. Inverter Control Switches. Two switches, placarded MAIN INVERTER and INERTIAL INVERTER, on the left subpanel give the pilot a choice of inverters to provide single-phase and three-phase AC power (fig. 2-14). Three inverters are involved in this selection.

NOTE

When inverters are switched the magnetic compass will be affected.

(1) Main inverter switch. The switch placarded MAIN INVERTER, OFF, and STBY provides a choice between two 2500 volt-ampere units for single-phase power. In the MAIN INVERTER (up) position, the unit selected is capable of single-phase output only, and is intended to provide single-phase power during normal flight operation. STBY position activates the alternate inverter for emergency single-phase power.

NOTE

When the MAIN INVERTER switch is OFF, the aircraft is deprived of all inverter-generated single-phase power regardless of the position of the INERTIAL INVERTER switch.

(2) *INS inverter switch.* The INS inverter switch placarded INERTIAL INVERTER, OFF, and STBY, selects three-phase power from the INS inverter rated at 750 volt-amperes or the STBY larger inverter rated at 2500 volt-amperes. With the switch in the INERTIAL INVERTER (up) position, either the INERTIAL or STBY inverter, or both, will operate as determined by automatic select circuitry, and the position of the INS mode switch. If the INS mode switch is in OFF, STBY, or ALIGN position, the STBY inverter will be energized. When the INS mode switch is in the NAV or AD (air data) position, the INERTIAL INVERTER will be energized. With the switch in the STBY (down) position, only the STBY inverter will operate.

NOTE

If the INERTIAL INVERTER is selected, and the MAIN INVERTER switch is in STBY position, the standby inverter will give power to the aircraft's systems and the INERTIAL INVERTER will come on automatically for INS operation.

NOTE

When the INERTIAL INVERTER switch is OFF, the aircraft is deprived of all three-phase power, regardless of the position of the MAIN INVERTER switch.

c. Inverter Control Circuit Breakers. Inverter control relay circuits are protected by 2-ampere circuit breakers on the copilot's circuit breaker and fuse panel. They are placarded INERTIAL INVERTER CONTROL (fig. 2-30). Added protection consists of a current limiter capable of stopping DC flow to the power relay.

2-80. Ground Fault Protection System **RU-21D**

CAUTION

Attempt generator reset one time only.

a. A ground fault detection and isolation system is integrated with the output cable from each generator to the respective generator bus, and with the tie-cable which links the two generator buses together. A short in either generator-to-generator-bus cable will cause the ground fault system to open the respective line contactor relay connecting the cable to the generator bus, and also stop power production from the affected generator. The FAULT WARN light will start to flash, and the LH GEN OUT or RH GEN OUT annunciator fault light will illuminate (fig. 2-37). To restore a generator to service, move the respective GEN switch to RESET position, then back to ON. If the ground fault has cleared, the generator will be operative, if not, the generator will not reset. If a generator will not reset, all aircraft DC loads will be supplied from the remaining generator and the aircraft battery.

b. A short in the tie-cable which links the two generator buses together will cause the ground fault system to open the line contactor relay at each end of the cable. This will isolate the faulted cable from power input and will also terminate power crossfeed between the two generating systems. Generator paralleling and balanced load sharing between the two units is lost. Both generators will remain in operation and all DC loads will continue to receive power. Each generator will supply power only to the distribution buses and other loads which connect to its repsective generator bus. The shorted tie-cable will be indicated to the pilot only by divergent readings on the two volt-loadmeters, which will display the unbalanced loads due to loss of paralleling. To restore connection of the bus tie-cable to the generator buses, and recouple the two generating systems, cycle the L GEN switch to RESET, then back to ON (fig. 2-14). If the fault has been cleared, bus-tie will be restored. If a fault persists, the ground fault system will maintain isolation of the tie-cable from power input, both generators will continue to operate, all DC loads will be supplied, and only paralleling and power crossfeed will be lost.

2-81. Bus Overload Protection System **RU-21D**

CAUTION

Do not reset the GND FAULT circuit breaker more than one time. If it trips after a reset no attempt should be made to reset the affected generator using the GEN 1 switch.

A bus overload and protection system is integrated with the respective generator buses and also with the battery-generator bus. A temperature actuated sensor detects the passage of excessive current through any of the buses designated, and will isolate the affected bus from current input and from connection with the rest of the system. Loss of the left generator bus is indicated by the flashing FAULT WARN light, illumination of the LH GEN OUT annunciator light, and by a no load reading on the left volt-loadmeter. In this case, all aircraft DC loads are supplied by the right generator, except for those loads which only receive power from the left generator. To restore operation of the left generator, and reconnect it to the respective generator bus, reset the LH GENERATOR RESET circuit breaker (fig. 2-14), then position the GEN 1 switch to RESET, then back to ON.

CAUTION

Do not attempt to reset a generator reset circuit breaker more than one time. If it trips again, after a reset attempt, no attempt should be made to reset the affected generator using the GEN 1 switch.

a. When right generator operation is terminated, and the right generator bus is disconnected, the indication will be as follows: the FAULT WARN light will flash, the RH GEN OUT annunciator light will illuminate, the RH GENERATOR RESET circuit breaker will trip on the right subpanel (of the copilot's circuit breaker and fuse panel if RHAW installed), and a no load reading will appear on the right volt-loadmeter. To restore operation of the right generator, and reconnect it to the generator bus, reset the RH GENERATOR RESET circuit breaker, then position the GEN 2 switch to RESET, then back to ON.

b. When a current overload is sensed on the battery-generator bus, the battery will be isolated from the bus, and the tie-cable which links the two generator buses will be disconnected. Both generators will continue to operate supplying all loads, although paralleling will be lost, and battery power will be lost to all circuits. Fault warning will consist of divergent load readings on the volt-loadmeters, illumination of a light within the BATTERY FAULT RESET button-switch (fig. 2-14). If the fault is of a momentary nature, battery power may be restored by pressing the BATTERY FAULT RESET button-switch to reset the circuit, and the light will extinguish. (Refer to chapter 9, Emergency Procedures.)

NOTE

Do not shut down an engine when the BATTERY FAULT RESET switch is illuminated, as power will not be available for the next engine start.

NOTE

A single bus overload should not cause the loss of more than one power source.

Section X. LIGHTING

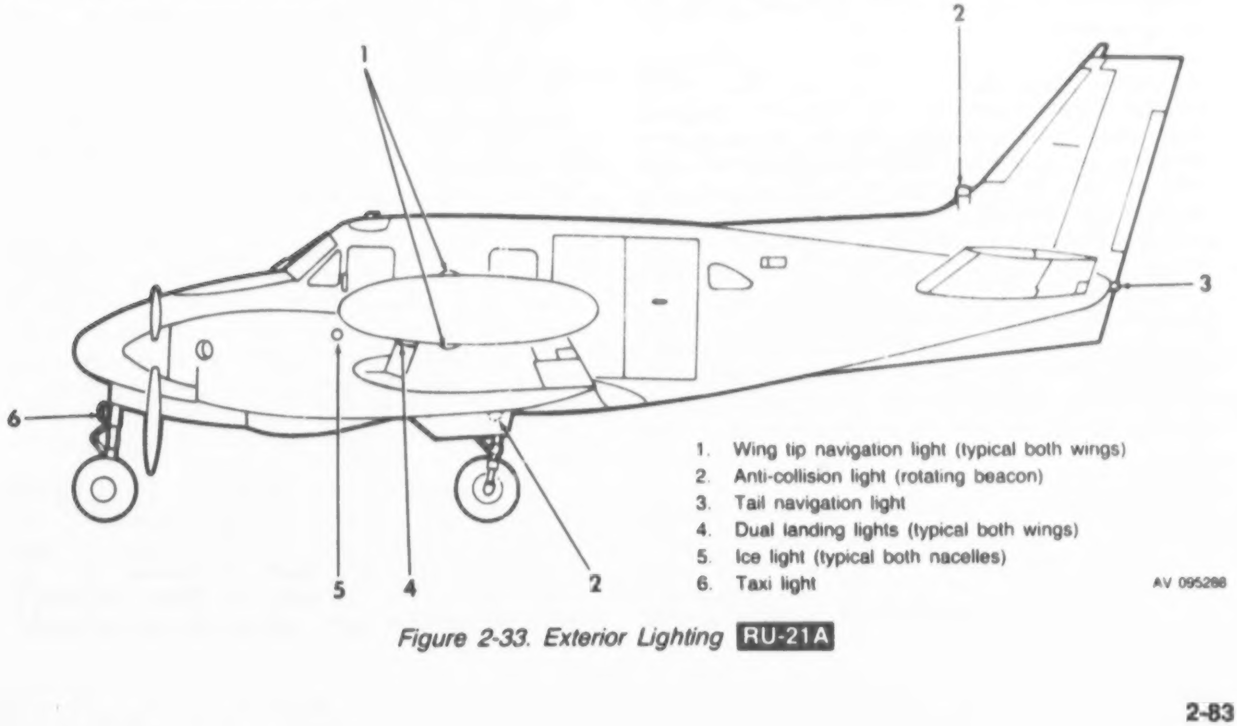
2-82. Exterior Lighting.

a. Description. Exterior lighting (fig. 2-33, 2-34) consists of conventional navigation lights on the tail section and on each wing tip, an anti-collision light (rotating beacon) on the vertical stabilizer and the underside of the fuselage center section, a single taxi light mounted on the nose landing gear strut, dual landing lights flush mounted in each wing leading edge near the wing tips, and two ice lights, one light flush mounted in each nacelle, positioned to illuminate along the outboard wing leading edge. All exterior lights are controlled by individual two-position circuit breaker switches on the left subpanel.

b. Exterior Lighting Circuit Breakers and switches. The navigation lights are controlled by a 5-ampere circuit breaker switch, placarded NAV, on the left subpanel (fig. 2-13, 2-14). The taxi light is controlled by a 15-ampere circuit breaker switch, placarded TAXI, on the left subpanel. The landing lights for each wing are controlled by individual circuit breaker switches, placarded LANDING LIGHTS, on the left subpanel. Both landing lights have redundant circuit protection. Each light switch has an internal 20-ampere circuit breaker element which is in series with a respective 20-ampere circuit breaker element which is in series with a respective 20-ampere circut breaker, placarded LANDING LIGHTS – LH, RH, located on the copilot's circuit breaker and fuse panel (fig. 2-29, 2-31). The beacon lights are controlled by a 10-ampere circuit breaker switch, placarded BEACON, on the left subpanel (fig. 2-13, 2-14). The two ice lights are controlled by a 5-ampere circuit breaker switch, placarded ICE, on the left subpanel. Placing any of the control switches ON completes the circuit to the associated light. In the event of circuit overload, the circuit breaker portion of the affected switch will disconnect the circuit from power and the switch arm will drop back to the OFF position. Repositioning a switch to the ON position will reset the circuit breaker.

2-83. Interior Lighting.

Instrument panel lighting is provided by individual post or eyebrow type red lights installed at the top edge of each instrument. In addition, instrument indirect lighting is provided by nine white lamps and nine red lamps located in the glareshield overhang along the top edge of the instrument panel. Additional cockpit lighting is furnished by two white flood lights flush mounted just aft of the overhead light control panel. Six individually-controlled lights are mounted in the cabin cold air outlet panels located along the ceiling in the cabin. In addition, one ajdustable dimmer controlled light is installed for each mission operator in the RU-21A. All aircraft



1. Wing tip navigation light (typical both wings)
2. Anti-collision light (rotating beacon)
3. Tail navigation light
4. Dual landing lights (typical both wings)
5. Ice light (typical both nacelles)
6. Taxi light

Figure 2-33. Exterior Lighting **RU-21A**

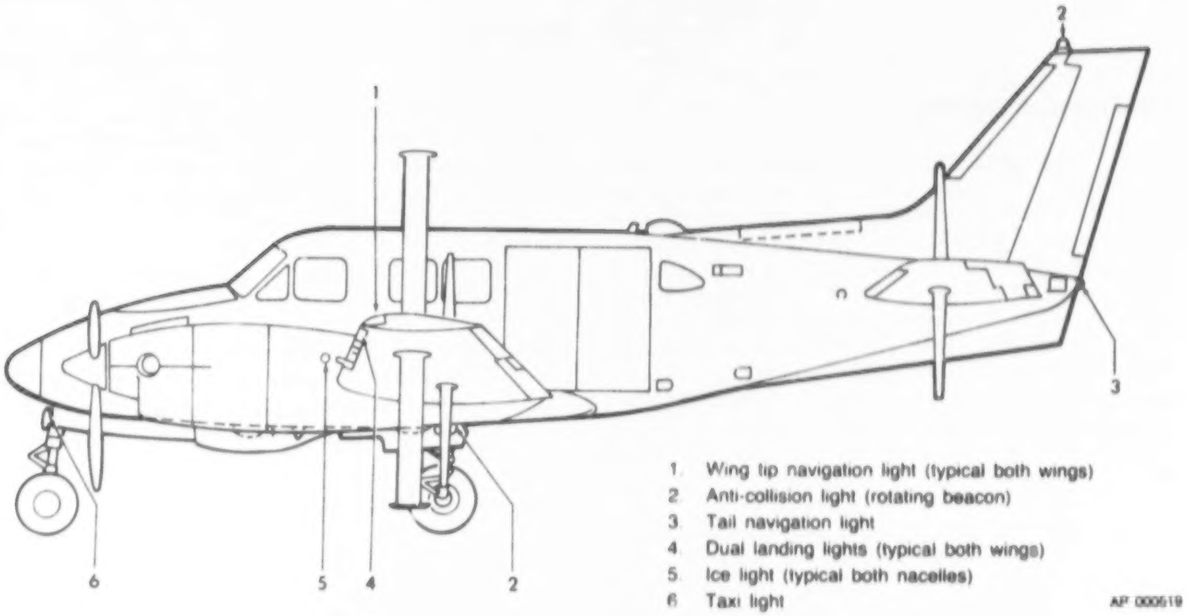

1
2
3
4
5
6
1. Wing tip navigation light (typical both wings)
2. Anti-collision light (rotating beacon)
3. Tail navigation light
4. Dual landing lights (typical both wings)
5. Ice light (typical both nacelles)
6. Taxi light
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Figure 2-34. Exterior Lighting **RU-21D**

interior lighting is controlled by either rheostat, press-to-light, or toggle type switches located on the overhead control panel in the cockpit. All switches are appropriately placarded as to their identity and function position (fig. 2-37).

a. Interior Lighting Circuit Breakers. Interior lighting circuits are protected by eight 5-ampere circuit breakers on the right subpanel under the group placard LIGHTS (fig. 2-29, 2-31). The circuit breaker ENG INST protects the engine instrument and radio panel light circuits. The FLT INST circuit breaker protects the magnetic compass, flight instruments, oxygen quantity indicator, deice pressure gage, and the free air temperature light circuits. The CABIN circuit breaker protects the reading light circuits of the cabin. The GYRO INST circuit breaker protects pilot gyro instrument lights. The RH SIDE PANEL circuit breaker protects lighting circuits for the copilot's circuit breaker and fuse panel. The OVHD circuit breaker protects the overhead control panel edge, the map light, cockpit red lights and fuel panel edge light circuits. The CONTROL PANEL circuit breaker protects the subpanel edge, pedestal edge, and instrument light circuits.

b. Interior Lighting Controls. One white flood light and two red map lights are mounted just aft of the overhead control panel (fig. 2-35). The overhead lights are controlled by the two rheostat switches, placarded OVERHEAD MAP LIGHTS and OVERHEAD FLOOD LIGHTS in the overhead control panel. The map and flood light circuits receive power from a 5-ampere circuit breaker, placarded OVHD on the right subpanel (fig. 2-13, 2-14).

c. Free Air Temperature Light. The free air temperature light is mounted overhead in the cockpit adjacent to the free air temperature gage. The light is operated by the push-button switch, placarded FREE AIR TEMP - PRESS TO LIGHT, (fig. 2-37), to illuminate the face of the gage. The light is protected by a 5-ampere circuit breaker on the right subpanel placarded FLT INST (fig. 2-13, 2-14). The free air temperature light is similar in constructions to the instrument post lights.

d. Magnetic Compass Light. The magnetic compass light, above the face of the compass, makes the compass card readable. This light is controlled by a rheostat-switch, placarded PILOT INSTRUMENT LIGHTS - BRT, OFF, located on the overhead control panel (fig. 2-35). This light is protected by a 5-ampere circuit breaker, placarded FLT INST, on the right subpanel (fig. 2-13, 2-14).

e. Edge Lighted Panels. The plastic cover panels on the subpanels and the copilot's circuit breaker and fuse panels are illuminated by edge lights. The edge-light socket is recessed into the plastic panel. The cap assembly which contains a red filter, screws down against the plastic panel.

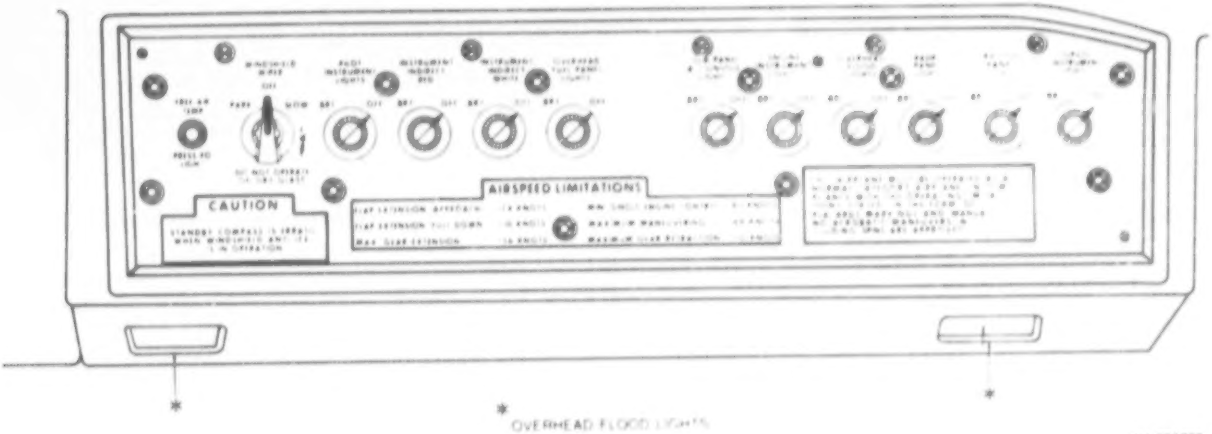


Figure 2-35. Overhead Control Panel

The edge lights on the subpanels are controlled by a rheostat-switch, placarded SUBPANEL & CONSOLE LIGHTS, on the overhead control panel (fig. 2-35). Edge light circuits receive power from a 5-ampere circuit breaker, placarded PED & SUBPANEL, located on the right subpanel (fig. 2-29, 2-31).

f. Overhead Lighting Controls. Several rheostat switches and one press-to-light switch on the overhead control panel control all cockpit lighting. For rheostat placarding, see figure 2-35.

g. Normal Operation of Interior Lights. All lights controlled from the overhead control panel are turned ON and OFF, and adjusted for brightness by rotating the rheostat controls. The initial clockwise rotation of any rheostat knob on the overhead control panel will turn ON the affected lighting circuit to dimmest illumination level. Further clockwise rotation progressively increases the brilliance of the lights. The passenger-controlled lights are energized by the switches mounted integrally with the lights.

Section XI. FLIGHT INSTRUMENTS

2-84. Airspeed Indicators.

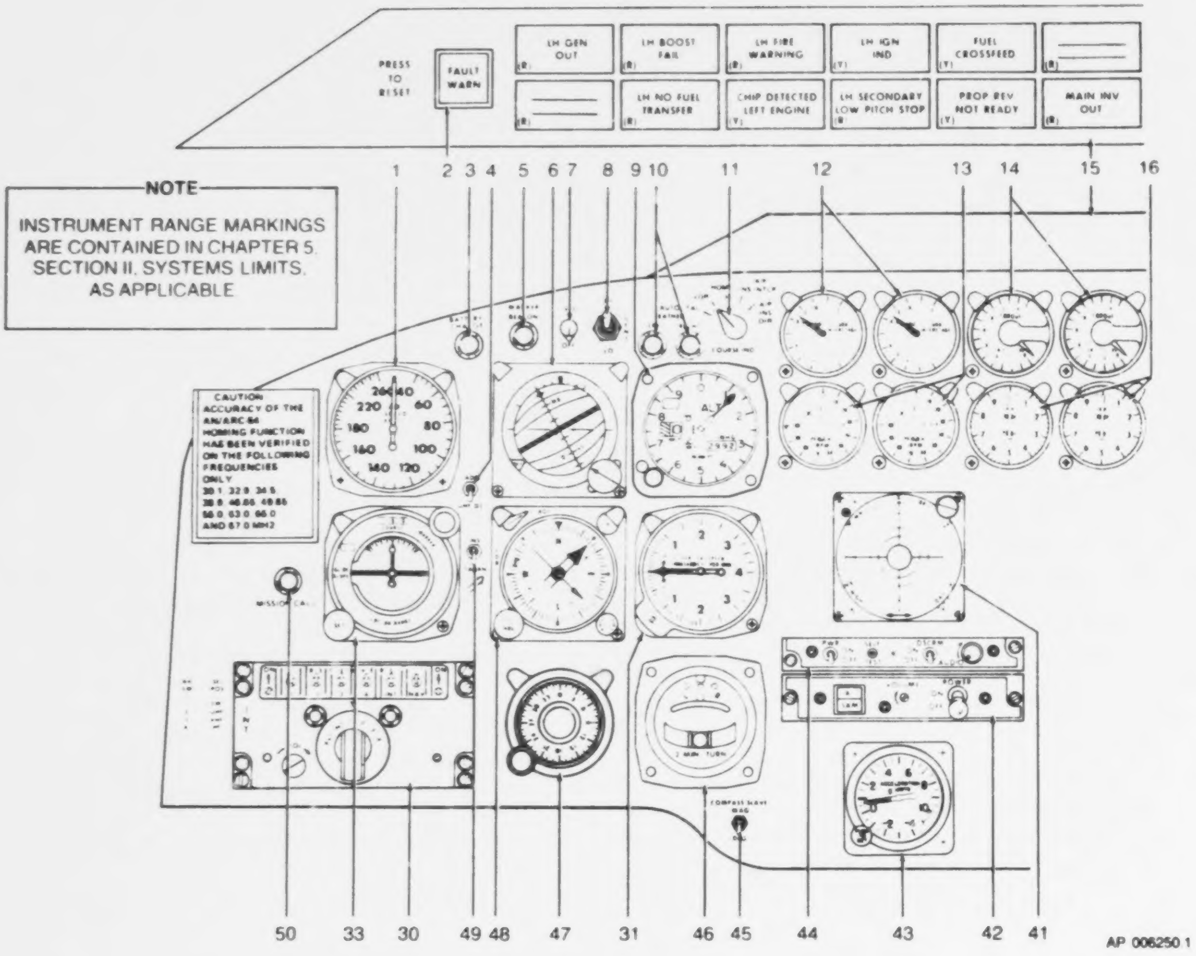
Two airspeed indicators are installed separately on the pilot and copilot sides of the instrument panel (fig. 2-36, 2-37). The indicator dials are calibrated in knots from 40 to 260.

2-85. Turn-And-Slip Indicators.

Two turn-and-slip indicators are installed separately on the pilot and copilot sides of the instrument panel. These indicators are gyroscopically operated. The pilot unit is operated by DC power and is protected by a 5-ampere circuit breaker, placarded TURN SLIP IND, on the right subpanel (fig. 2-13, 2-14). The copilot's indicator is driven by the aircraft vacuum system.

2-86. Pilot's Encoding Altimeter.

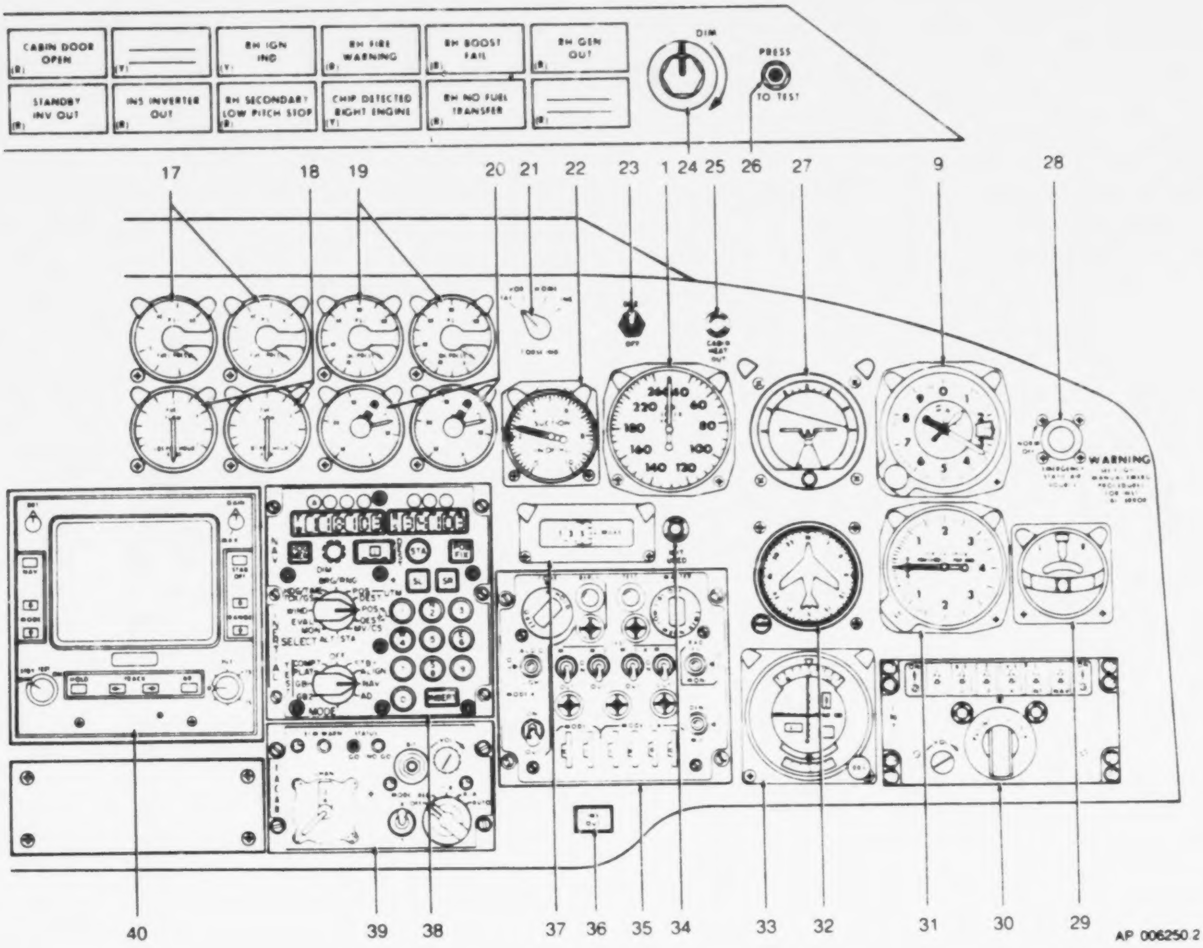
The altimeter is located on the upper left side of the instrument panel (fig. 2-36, 2-37). The altimeter is a self-contained unit which consists of a sensitive pressure altimeter combined with an altitude encoder. The display indicates and the encoder transmits, simultaneously, pressure altitude reporting. Altitude is displayed on the altimeter by a 10,000 foot counter, a 1000 foot counter, and a single needle pointer which indicates hundreds of feet on a circular scale in 50 foot increments. Below an altitude of 10,000 feet, a diagonal warning symbol will appear on the 10,000 foot counter. A barometric pressure setting knob is provided to insert the desired altimeter setting in inches Hg. A DC powered vibrator operates inside the altimeter whenever aircraft power is on. If DC power to the altitude encoder is lost, a warning flag


NOTE

INSTRUMENT RANGE MARKINGS ARE CONTAINED IN CHAPTER 5, SECTION II, SYSTEMS LIMITS, AS APPLICABLE.

1. Airspeed indicators
2. Fault warning indicator light
3. Battery charge indicator light
4. ADF/UHF-DF switch
5. Marker beacon indicator light
6. Pilot's attitude indicator
7. Marker beacon/glideslope control
8. Marker beacon sensitivity control
9. Altimeters
10. Propeller autofeather arm lights
11. Course indicator-selector switches
12. Interstage turbine temperature gages
13. Turbine tachometers
14. Torquemeters
15. Annunciator panel
16. Propeller tachometers
17. Fuel pressure gages
18. Fuel flow gages
19. Oil pressure gages
20. Oil temperature gages
21. Copilot's course indicator-selector switch
22. Instrument air pressure gage
23. DME switch
24. Dim control, annunciator lights
25. Cabin heat out light

Figure 2-36. Instrument Panel **RU-21A** *(Sheet 1 of 2)*



26. Annunciator press to test switch
27. Copilot's attitude indicator
28. Emergency static air source control
29. Copilot's turn and slip indicator
30. Audio control panels
31. Vertical velocity indicators
32. Copilot's directional indicator
33. Course indicator-selectors
34. Not used
35. Transponder control panel
36. INS out light
37. TACAN distance indicator
38. INS control panel
39. TACAN control panel
40. Weather radar control-indicator
41. Radar signal detecting set indicator
42. Radar warning reciever control panel
43. Accelerometer
44. Radar signal detecting set
45. Compass slave switch
46. Pilot's turn and slip indicator
47. Autopilot heading selector
48. Pilot's RMI
49. INS-TACAN switch
50. Mission call switch

Figure 2-36. Instrument Panel **RU-21A** *(Sheet 2 of 2)*

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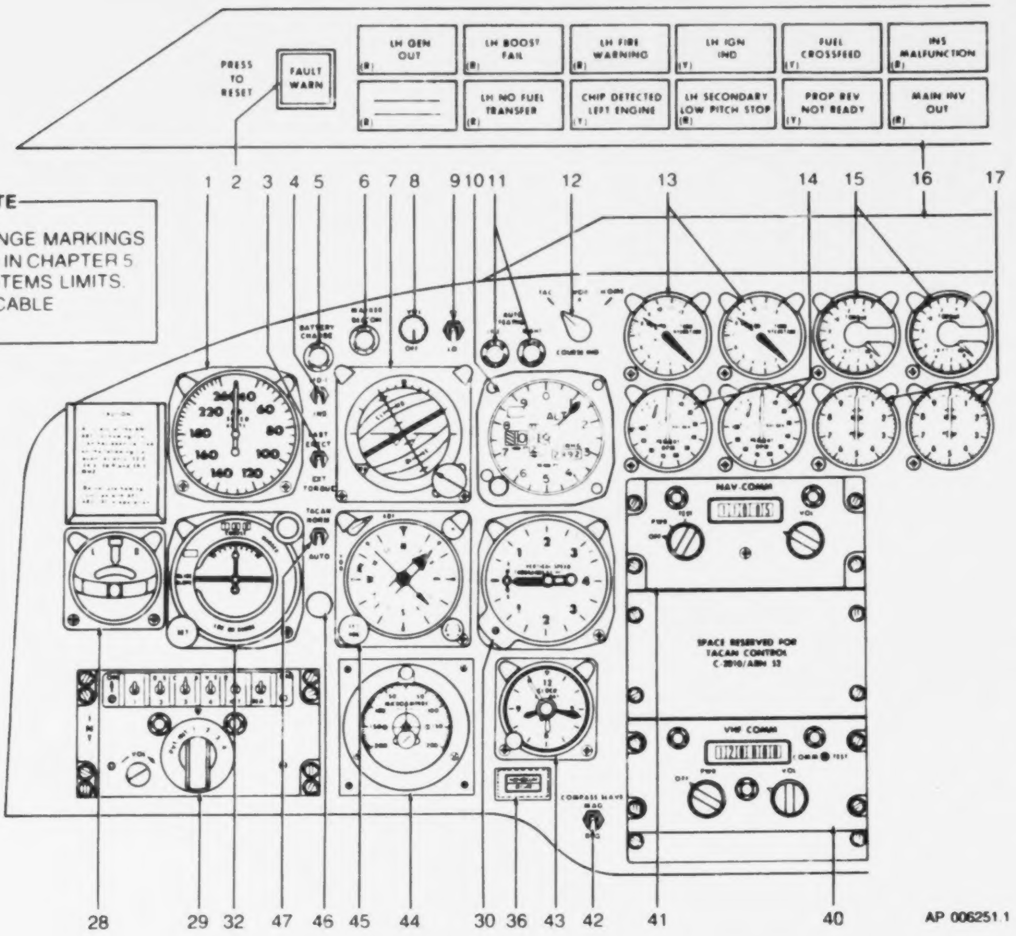
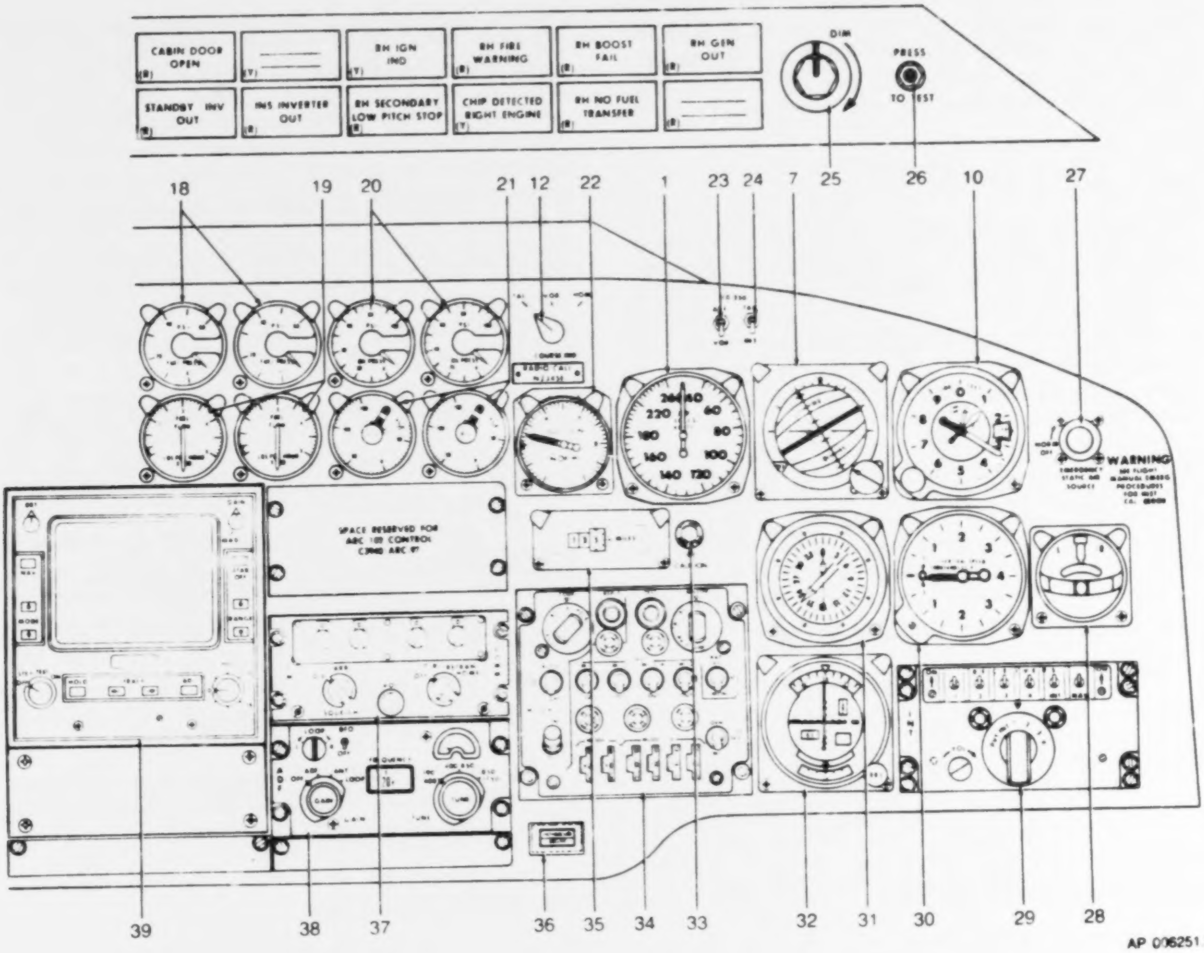
NOTE

INSTRUMENT RANGE MARKINGS ARE CONTAINED IN CHAPTER 5 SECTION II, SYSTEMS LIMITS, AS APPLICABLE



1. Airspeed indicators
2. Fault warning light
3. External torque-fast erect switch
4. MD-1 - INS switch
5. Battery charge indicator light
6. Marker beacon indicator light
7. Attitude indicators
8. Marker beacon/glideslope control
9. Marker beacon sensitivity control
10. Altimeters (pilot's encoding)
11. Propeller autofeather arm lights
12. Course indicator-selector switches
13. Interstage turbine temperature gages
14. Turbine tachometers
15. Torquemeters
16. Annunciator panel
17. Propeller tachometers
18. Fuel pressure gages
19. Fuel flow gages
20. Oil pressure gages
21. Oil temperature gages
22. Instrument air pressure gage
23. ADF-VOR switch
24. TACAN-INS switch

Figure 2-37. Instrument Panel **RU-21D** *(Sheet 1 of 2)*



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25. Dim control, annunciator lights
26. Press to test switch - annunciator lights
27. Emergency static air source control
28. Turn and slip indicators
29. Audio control panels
30. Vertical velocity indicators
31. Copilot's RMI
32. Course indicator-selector
33. IFF caution indicator light
34. Transponder control panel
35. TACAN distance indicator
36. Secure, non-secure indicator lights
37. FM control panel
38. ADF control panel
39. Weather radar control-indicator
40. VHF control panel
41. VOR control panel
42. Compass slave switch
43. Clock
44. Null meter
45. Pilot's RMI
46. TACAN disable indicator light
47. TACAN NORM-AUTO switch

Figure 2-37. Instrument Panel **RU-21D** *(Sheet 2 of 2)*

placarded CODE OFF will appear in the upper left portion of the instrument face, indicating that the altitude encoder is inoperative and that the system is not reporting altitude to ground stations. For operating instructions, refer to chapter 3.

2-87. Copilot's Altimeter.

The copilot's altimeter is located on the upper right side of the instrument panel and requires no electrical power for operation. The altitude is indicated in hundreds of feet by a long pointer, in thousands of feet by a second pointer, and in ten-thousands of feet by a disc mounted pointer. A barometric pressure setting knob is provided to insert the desired altimeter setting in inches Hg. An alternate unit may be installed which is similar in appearance to the pilot's encoding altimeter and which requires DC power for proper operation. It does not contain the CODE OFF flag and does not have altitude encoding capability.

2-88. Vertical Velocity Indicators.

Two vertical velocity indicators are installed separately on the pilot and copilot sides of the instrument panel (fig. 2-36, 2-37). They indicate the speed at which the aircraft ascends or descends based on changes in atmospheric pressure. The indicator is a direct reading pressure instrument.

2-89. Accelerometer RU-21A

The accelerometer (fig. 2-36), located on the instrument panel registers and records positive and negative G loads imposed on the aircraft. One hand moves in the direction of the G load being applied while the other two, for positive G loads and one for negative G loads, follow the indicating pointer to its maximum travel. The recording pointers remain at the respective maximum travel positions of the G's being applied, providing a record of maximum G loads encountered. Depressing the push-to-reset knob at the lower left corner of the instrument allows the recording pointers to return to the normal position.

2-90. Attitude Indicators.

Two indicators (fig. 2-36, 2-37) on the instrument panel, display aircraft pitch and bank attitudes. On RU-21D aircraft, the pilot's indicator is provided signals from the INS or the MD-1 gyro select switch. On RU-21A aircraft, the pilot's indicator is provided signals from the INS only. Refer to chapter 3 for coverage. The copilot's attitude indicator is vacuum operated. This unit functions independently of the pilot's indicator, and has self-contained gyros to erect the sphere and provide inertial reference. An indicating plane in front of the face of the instrument represents the aircraft and a movable horizontal bar behind the indicating plane represents the horizon. The indicating plane may be adjusted vertically by means of a small knob located at the lower edge of the indicator front to correct for variations in level flight attitude at different airspeeds. This unit is designed to operate through all attitudes and need not be caged for any maneuver.

a. Gyro Selector Switch RU-21D One MD-1/INS switch on the instrument panel allows the pilot to select the source of gyro input for his attitude indicator (fig. 2-37). Refer to chapter 3.

b. External Torque and Fast Erect Switch RU-21D One EXT TORQUE/FAST ERECT switch on the instrument panel allows the pilot to control the alignment and test of the vertical gyros for his attitude indicator (fig. 2-37). Refer to chapter 3.

2-91. Free Air Temperature Gage.

The free air temperature gage, centered above the windshield (fig. 2-9, 2-10) indicates the outside air temperature in degrees Celsius.

2-92. Magnetic Compass.

The magnetic compass is located on the top of the windshield divider (fig. 2-9, 2-10). A compass correction chart indicating deviation is located adjacent to the magnetic compass.

2-93. Directional Indicator RU-21A

One instrument, on the copilot's instrument panel, indicates the heading in degrees (fig. 2-36). This indicator operates from a regulated instrument vacuum source and is used as a standby instrument in the event of gyro magnetic compass failure. Since the instrument is not magnetically slaved, it will show apparent drift due to the earth's rotation. The amount of drift will depend upon the latitude at which the aircraft is flying. Therefore, the indicator should be adjusted to the proper magnetic heading during the lineup check prior to takeoff. When flying straight and level for extended periods of time, it should be checked and reset as necessary in order to maintain the desired heading. The indicator is equipped with a caging (heading adjustment) knob located on the exterior below the dial face, which can be rotated in either direction while the indicator is caged. Pushing the knob in cages the indicator and pulling it out uncages.

2-94. Radio Magnetic Indicators (RMI).

Two RMI indicators on the RU-21D instrument panel are navigation aids providing aircraft heading and bearing information (fig. 2-37). For the RU-21A, the pilot is provided one RMI unit (fig. 2-36), and the copilot has the directional indicator unit described in the preceding paragraph. Refer to chapter 3. A switch, placarded COMPASS SLAVE, on the pilot's instrument panel, controls the RMI gyro slaving circuit (fig. 2-36, 2-37). Refer to chapter 3, Avionics, for coverage.

2-95. Microampere Meter RU-21D

One microampere meter (fig. 2-37) is mounted on the pilot's instrument panel and is used in conjunction with mission equipment. Refer to TM 11-5825-252-15 for complete coverage.

2-96. Inertial Navigation System.

Refer to chapter 3 for description and operation of the Inertial Navigation System (INS).

2-97. Miscellaneous Instruments.

a. Annunciator Panel. The annunciator panel is positioned across the glareshield of the instrument panel in direct view of the pilot (fig. 2-36, 2-37). This panel provides for monitoring critical functions of the aircraft and indicates conditions for which the pilot must take appropriate action. In frontal view this panel presents two rows of small, rectangular windows, (lights) some colored yellow and some colored red. Word-printing on individual lights identifies the monitored function or fault condition. Active elements include a flashing FAULT WARN light, individual function and fault lights, and DIM and PRESS TO TEST controls. When a 'fault' condition is present, the appropriate annunciator legend window illumiates continuously and the red FAULT WARN button flashes on and off. All 'fault' legends illuminate red, except for the CHIP DETECTED fault legend, which illuminates yellow. Each 'function' legend illuminates yellow during the designated function.

NOTE

> The FAULT WARNING LIGHT will flash whenever the yellow CHIP DETECTED legend illuminates. The FAULT WARNING LIGHT will not flash or illuminate when the red MAIN INV OUT, INS INV OUT or STANDBY INV OUT legends illuminate.

(1) Fault warn light. If a fault should occur, (example: LH GEN OUT) a signal from the fault sensor is sent to its respective light (in this case: red) in the annunciator panel. A parallel signal is also directed to activate the flashing FAULT WARN light (fig. 2-36, 2-37). This light will continue to flash after fault correction unless reset by pressing its face. Reset will extinguish the light, however, a second fault will cause it to illuminate again.

(2) Indicating function. If an indicating function should occur, (example: LH IGN IND), a signal from the indicator sensor is sent to its respective circuit in the same manner as a fault signal. However, an indicating function will not cause the FAULT WARN light to flash.

(3) Dimming control. The intensity of all lights in the annunciator panel are dimmed by a common DIM control (fig. 2-36, 2-37). When a signal is sent to the panel, the affected light illuminates at maximum brightness. When the FAULT WARN light is reset, the lights will dim to the level set by the DIM control. Dimming cannot be accomplished until after reset. Circuits of the annunciator are protected by a 5-ampere circuit breaker, placarded ANN PANEL, on the right subpanel (fig. 2-13, 2-14).

b. Other Instruments. Other instruments not previously described, include an eight day manually wound clock, located in the center of the pilot's control wheel (fig. 2-9, 2-10), and a suction gage (fig. 2-36, 2-37), located on the copilot's side of the instrument panel.

Section XII. SERVICING, PARKING, AND MOORING

2-98. General.

The following paragraphs include the procedures necessary to service the aircraft, except lubrication (fig. 2-38). The lubrication requirements of the aircraft are covered in TM 55-1510-209-20/1. Refer to tables 2-5, 2-6, 2-7, and 2-8 for identification of fuel, oil, etc., used to service the aircraft. The servicing instructions provide procedures and precautions necessary to service the aircraft.

2-99. Servicing Fuel System.

The fuel system is made up of a 57 gallon (370.5 pounds) nacelle tank and wing tank fuel cells of 128 gallons (832 pounds) capacity, making a total fuel capacity of 370 gallons (2,405 pounds).

NOTE

Service fuel tanks after each flight to keep the bladder type tanks from drying out.

NOTE

At least thirty minutes after servicing the tanks, open the sump drains and fuel strainer drains and allow a small amount of fuel to drain from each of these points.

NOTE

Settling time for AVGAS is 15 minutes per foot of tank depth and one hour per foot depth for jet (JP) fuels. Allow the fuel to settle for the prescribed period before any fuel samples are taken.

a. Fuel Handling Precautions. While handling fuel it is well to remember that even though the aircraft uses JP-4 (primary) and JP-5 (alternate) as its principle fuel, it may be operated on aviation gasoline as an emergency fuel.

WARNING

When aviation gasoline is used in a turbine engine, extreme caution should be used when around the combustion chamber and exhaust area to avoid cuts or abrasions. The exhaust deposits contain lead oxide which will cause lead poisoning.

CAUTION

Proper procedures for handling JP-4 and JP-5 fuel cannot be over stressed. Clean, fresh fuel must be used and the entrance of water into the fuel storage or aircraft fuel system must be kept to a minimum.

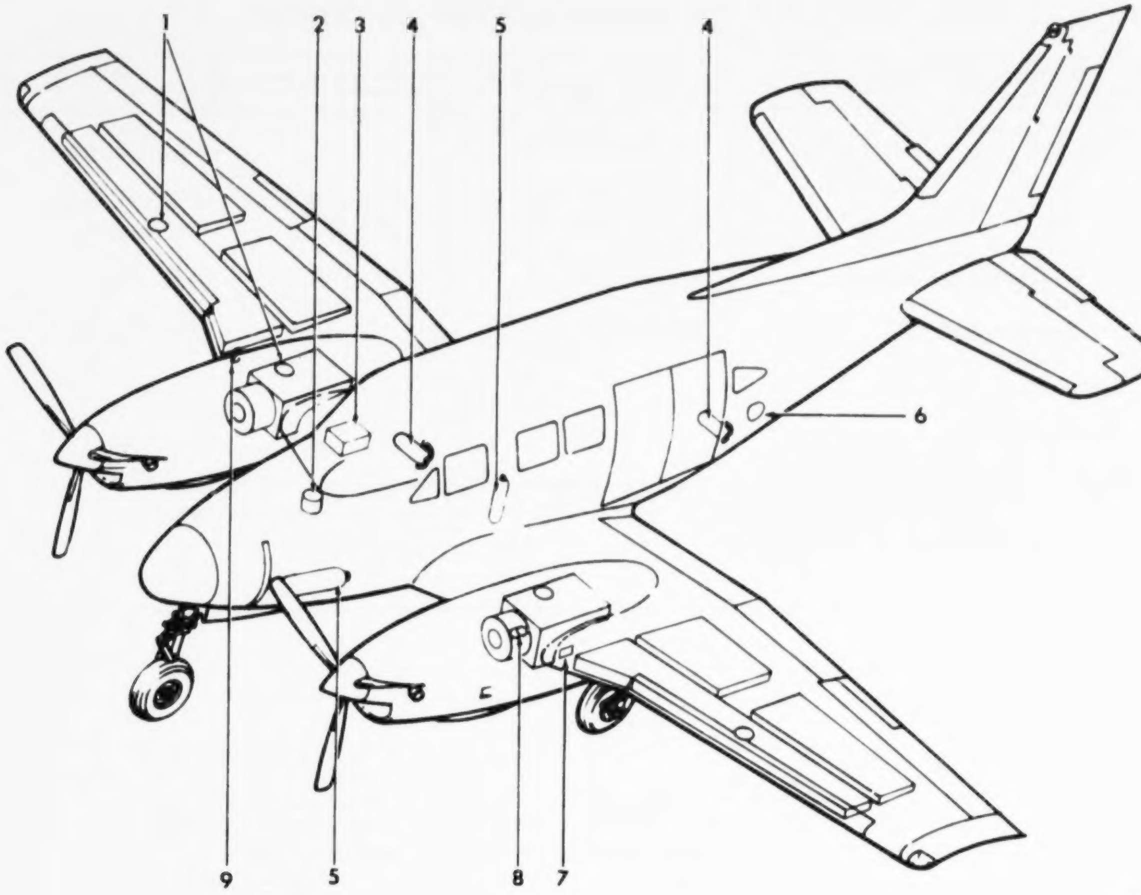
CAUTION

When conditions permit, the aircraft should be positioned so that the wind will carry the fuel vapors away from all possible sources of ignition. The fuel vehicle shall be positioned to maintain a minimum distance of 10 feet from any part of the aircraft, while maintaining a minimum distance of 20 feet between the fueling vehicle and the fuel filler point.

NOTE

The use of aviation gasoline as an emergency fuel is permitted for a period of not more than 150 hours during time between engine overhauls (TBO). A mixture of more than 10% aviation gasoline shall be entered on DA Form 2408-13. The lowest octane aviation gasoline available is recommended to avoid build up of deposits on turbine blades.

1. Shut off all electrical equipment on the aircraft, including radar and radar equipment. The master switch may be left on, but it must not be moved during the fueling operation. Do not allow operation of any electrical tools, such as drills or buffers, in or near the aircraft during fueling.



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1. Fuel tank filler caps (typical left and right) fuel: spec. MIL-T-5624 (JP-4 or JP-5)
2. Wheel brake hydraulic fluid reservoir: spec. MIL-H-5606
3. Battery
4. Fire extinguishers, hand type, CF_3Br, extinguishing agent: spec. MIL-E-52031 monobromotrifluoromethane, 2¾ pound capacity
5. Oxygen supply cylinders, breathing oxygen: spec. MIL-O-2710
6. Oxygen filler valve
7. AC external power receptacle (110 volt, single phase, RU-21A only)
8. Engine oil filler caps (typical, left and right), engine oil: spec. MIL L-7807, synthetic base, -40°F (-40°C) and below, engine oil: spec. MIL-L-23699, synthetic base above -40°F (-40°C)
9. External power receptacle (24 - volt)

Figure 2-38. Servicing Diagram

Table 2-5. Fuel, Lubricants, Specifications and Capacities

SYSTEM	SPECIFICATION	CAPACITY
Fuel	MIL-T-5624 (JP-4)	373.6 U.S. Gals.
Engine oil	MIL-L-7808 (See Notes 1, 3, and 4) MIL-L-23699 (See Notes 2 and 3)	14 U.S. Quarts per engine
Hydraulic brake system	MIL-H-5606	1 U.S. Pint
Oxygen system	MIL-O-27210	203 Cubic feet

NOTE 1: MIL-L-7808 oil used in the engine oil system is specified for operation in ambient temperatures below −40°C (−40°F). This oil may also be used when MIL-L-23699 oil is not available.

NOTE 2:

CAUTION

Under no circumstances shall MIL-L-23699 oil be used at ambient temperatures below −40°C (−40°F). MIL-L-23699 oil used in engine oil system is authorized and directed for use in ambient temperatures above −40°C (−40°F).

NOTE 3:

CAUTION

Do not mix MIL-L-23699 oil with MIL-L-7808 oil except in case of emergency. If it becomes necessary to mix the oils, the applicable system shall be flushed within six hours and filled with the proper oil.

NOTE 4:

CAUTION

Lubrication oil made to MIL-L-7808 by Shell Oil Company under their part number 307, qualification number 7D-1 shall NOT be used in U-21 series engines.

Table 2-6. Approved Oils

SPECIFICATION	PRODUCT	VENDOR
MIL-L-23699 (5 centistokes)	Esso Turbo Oil 2380	Exxon International Co. New York, NY Toronto, Ontario, Canada
	Exxon Turbo Oil 2380	Exxon Co Houston, Texas
	Aero Shell Turbine Oil 500	Shell Oil Co. Houston, Texas Toronto, Ontario, Canada
	Stauffer Jet II	Stauffer Co. Westport, CT
	Castrol 5000	United Kingdom

2. Refuel aircraft as soon as possible after landing.

3. Keep fuel servicing nozzles free of snow, water, and mud at all times.

WARNING

Prior to opening the fuel tank filler, the hose nozzle static ground wire must be attached to the grounding lugs that are located adjacent to filler openings.

4. Carefully remove snow, water, and ice from the aircraft fuel filler cap area before removing the fuel filler cap. Remove only one aircraft tank filler cap at any one time, and replace each one immediately after the servicing operation is completed.

5. Wipe all frost from fuel filler necks before servicing.

6. Drain water from fuel tanks, filter cases, and pumps at least 30 minutes after each servicing, at least 30 minutes after each removal from heated shelter, and before each flight. Preheat, when required, to insure free fuel drainage.

7. Insofar as possible, leave only fully serviced aircraft outside.

8. Avoid dragging the fueling hose where it can damage the soft, flexible surface of the deicer boots.

9. Insure that the aircraft and components being serviced are securely coupled to a low resistance ground. Connect the static ground cable and the fueler to a grounding stake. When engaged in the fueling operation, discharge the static electricity accumulated by the body and clothing by touching the ground cable or stake before each operation.

10. Observe NO SMOKING precautions.

11. Prior to transferring the fuel, insure that the hose is grounded to the aircraft.

12. Wash off spilled fuel immediately.

13. Handle the fuel hose and nozzle cautiously to avoid damaging the wing skin.

14. Do not conduct fueling operations within 100 feet of energized airborne radar equipment or within 300 feet of energized ground radar equipment installations.

15. Wear only nonsparking shoes near aircraft or fueling equipment, as shoes with nailed soles or metal heel plates can be a source of sparks.

Table 2-7. Approved Fuels

SOURCE	PRIMARY OR STANDARD FUEL	ALTERNATE FUEL	
US Military Fuel	JP-4 (MIL-T-5624)	JP-5 (MIL-T-5624)	
NATO Code No.	F-40 (Wide Cut Type)	F-44 (High Flash Type)	
COMMERICAL FUEL (ASTM-D-1655)	JET B	JET A	JET A-1 NATO F-34
American Oil Co.	American JP-4	American Type A	
Atlantic Richfield	Arcojet B	Arcojet A	Arcojet A-1
Richfield Div.		Richfield A	Richfield A-1
B. P. Trading	B.P.A.T.G.		B.P.A.T.K.
Caltex Petroleum Corp.	Caltex Jet B		Caltex Jet A-1
Cities Service Co.		CITGO A	
Continental Oil Co.	Conoco JP-4	Conoco Jet-50	Conoco Jet-60
Gulf Oil	Gulf Jet B	Gulf Jet A	Gulf Jet A-1
EXXON Co., USA	EXXON Turbo Fuel B	EXXON A	EXXON A-1
Mobil Oil	Mobil Jet B	Mobil Jet A	Mobil Jet A-1
Philips Petroleum	Philjet JP-4	Philjet A-50	
Shell Oil	Aeroshell JP-4	Aeroshell 640	Aeroshell 650
Sinclair		Superjet A	Superjet A-1
Standard Oil Co.		Jet A Kerosene	Jet A-1 Kerosene
Chevron	Chevron B	Chevron A-50	Chevron A-1
Texaco	Texaco Avjet B	Avjet A	Avjet A-1
Union Oil	Union JP-4	76 Turbine Fuel	
FOREIGN FUEL	NATO F-40	NATO F-44	
Belgium	BA-PF2B		
Canada	3GP-22F	3-6P-24e	
Denmark	JP-4 MIL-T-5624		
France	Air 3407A		
Germany (West)	VTL-9130-006	UTL-9130-007/UTL 9130-010	
Greece	JP-4 MIL-T-5624		
Italy	AA-M-C-1421	AMC-143	
Netherlands	JP-4 MIL-T-5624	D. Eng RD 2493	
Norway	JP-4 MIL-T-5624		
Portugal	JP-4 MIL-T-5624		
Turkey	JP-4 MIL-T-5624		
United Kingdom (Britain)	D. Eng RD 2454	D. Eng RD 2498	

NOTE:

Anti-icing and Biocidal Additive for Commercial Turbine Engine Fuel - The fuel system icing inhibitor shall conform to MIL-I-27686. The additive provides anti-icing protection and also functions as a biocide to kill microbial growths in aircraft fuel systems. Icing inhibitor conforming to MIL-I-27686 (PRIST) shall be added to commercial fuel, not containing an icing inhibitor, during refueling operations, regardless of ambient temperatures. Refueling operations shall be accomplished in accordance with accepted commercial procedures. Refer to paragraph 2-100 (c).

Table 2-8. Standard, Alternate and Emergency Fuels

ENGINE	ARMY STANDARD FUEL	ALTERNATE FUEL	EMERGENCY FUEL	
			TYPE	*MAX. HOURS
T74-CP-700	MIL-T-5624 Grade JP-4	MIL-T-5624 Grade JP-5	MIL-G-5572 Any AV Gas	150

*Maximum operating hours with indicated fuel between engine overhauls (TBO).

b. *Fuel Handling Precautions For Extreme Weather Conditions.* When fueling is conducted on ice or on sandy or desert terrain, or when a satisfactory ground cannot be secured, additional precautions must be taken to avoid the buildup of static electricity. Refer to TM 55-410. Since draining the static charges is not possible without an adequate ground, reliance must be placed on equalizing the potentials in order to prevent a dangerous sparking discharge as in the following bonding procedure:

1. Connect ground cable from fuel servicing unit to satisfactory ground, such as a grounding post.

2. Connect grounding cable to some convenient unpainted metal part of aircraft, excluding propellers or antennas.

3. Connect bonding cable from aircraft to fuel servicing unit. A conductive-type fuel hose is not a satisfactory method of bonding.

4. Connect bonding cable from fuel nozzle to aircraft before fuel tank cover is opened.

5. When disconnecting, reverse the order of steps 1 through 4.

c. *Blending Anti-icing Additives to Fuel.*

CAUTION

Insure that the additive is directed into the flowing fuel stream; start additive flow after fuel flow starts, and stop before fuel flow stops. Do not allow concentrated additive to contact coated interior of fuel cells or aircraft painted surfaces. Use not less than 20 fl oz of additive per 260 gallons of fuel or more than 20 fl oz of additive per 104 gallons of fuel.

The following procedure is to be used when blending anti-icing additive (which must conform to specification MIL-I-27686) with the fuel as the aircraft is being refueled:

1. Using "HI-FLO PRIST" blender (Model PHF-204), remove cap containing the tube and clip assembly.

2. Attach pistol grip on collar.

3. Press tube into button.

4. Clip tube end to fuel nozzle.

5. Pull trigger firmly to ensure full flow, then lock in place.

6. Start flow of additive when refueling begins. (Refueling should be at a rate of 30 to 60 gallons per minute. A rate of less than 30 gallons per minute may be used when topping off tanks.)

d. *Filling Fuel Tanks.* Fill tanks as follows:

1. Attach bonding cables to aircraft.

2. Attach bonding cable from hose nozzle to ground socket adjacent to fuel tank being filled.

3. Always fill nacelle tank before wing tank.

4. Open applicable fuel tank filler cap.

5. Fill fuel tank with fuel.

6. Secure applicable fuel tank filler cap.

CAUTION

Make sure fuel filler cap latch tab is pointed aft.

7. Disconnect bonding cables from aircraft.

e. Filling Ferry Fuel System Tanks. Fill ferry system tanks in accordance with procedures and safety precautions which are used in filling the aircraft's regular fuel tanks. Observe placard on ferry system tanks which reads FERRY TANK CAPACITY 120 U.S. GALLONS. FILL TO BOTTOM OF TAB ON FILLER NECK. USE AVIATION KEROSENE OR SEE PILOT'S OPERATING MANUAL FOR ALTERNATES.

f. Draining Moisture From Fuel System. To remove moisture and sediment from the fuel system, 10 fuel drains are installed. The locations are as follows: one outboard of nacelle, one in the main gear wheel well (low point of fuel system), one just ahead of wheel well (to drain boost pumps), one inboard of nacelle (to drain transfer pumps), and one at the inertial separator air bypass duct (to drain fuel filter).

g. Fuel Types. Approved fuel types are as follows:

(1) Army standard fuels. These are the Army-designated primary fuels adopted for worldwide use, and are the only fuels available in the Army supply system.

(2) Alternate fuels. These are fuels which can be used continuously when Army standard fuel is not available, without reduction of power output. Power setting adjustments and increased maintenance may be required when an alternate fuel is used.

(3) Emergency fuel. These are fuels which can be used if Army standard and alternate fuels are not available. Their use is subject to a specific time limit.

h. Use of Fuels. Fuel is used as follows:

(1) Fuel limitations. There is no special limitation on the use of Army standard fuel, but certain limitations are imposed when Alternate or Emergency fuels are used. For the purpose of recording, fuel mixtures shall be identified as to the major component of the mixture, except when the mixture contains leaded gasoline. A fuel mixture which contains over 10 percent leaded gasoline shall be recorded as all leaded gasoline. The use of any fuels other than standard will be entered in the FAULTS/REMARKS column of DA Form 2408-13, Aircraft Maintenance and Inspection Record, noting the type of fuel, additives, and duration of operation.

(2) Use of kerosene fuels. The use of kerosene fuels (JP-5 type) in turbine engines dictates the need for observance of special precautions. Both ground starts and air restarts at low temperature may be more difficult due to low vapor pressure.

(3) Mixing of fuels in aircraft tanks. When changing from one type of authorized fuel to another, for example JP-4 to JP-5, it is not necessary to drain the aircraft fuel system before adding the new fuel.

(4) Fuel specifications. Fuels having the same NATO code number are interchangeable. Jet fuels conforming to ASTM D-1655 specification may be used when MIL-T-5624 fuels are not available. This usually occurs during cross country flights where aircraft using NATO F-44 (JP-5) are refueled with NATO F-40 (JP-4) or Commerical ASTM Type B fuels. Whenever this condition occurs, the engine operating characteristics may change in that lower operating temperature, slower acceleration, lower engine speed, easier starting, and shorter range may be experienced. The reverse is true when changing from F-40 (JP-4) fuel to F-44 (JP-5) or Commercial ASTM Type A-1 fuels. Most commerical turbine engines will operate satisfactorily on either kerosene or JP-4 type fuel. However, the difference in specific gravity may possibly require fuel control adjustments; if so, the recommendations of the manufacturers of the engine and airframe are to be followed.

2-100. Servicing Oil System.

CAUTION

Do not mix MIL-L-23699 oil with MIL-L-7808 oil except in case of emergency. If it becomes necessary to mix the oils, the applicable system shall be flushed within six hours and filled with the proper oil.

CAUTION

Make sure oil filler cap latch tab is pointed aft.

An integral oil tank occupies the cavity formed between the accessory gearbox housing and the compressor inlet case on the T74-CP-700 engine.

The tanks have a total oil capacity of 2.3 gallons and features a calibrated oil dipstick and an oil drain plug. If engine has been stationary for more than 12 hours, carry out a motoring run (no ignition) before checking oil level. Avoid spilling oil. Any oil spilled must be removed immediately. Use a cloth moistened in solvent to remove oil. Overfilling may cause a discharge of oil through the accessory gearbox breather until a satisfactory level is reached. Service oil system as follows:

1. Open the upper rear cowling to gain access to the oil filler cap and dipstick.

2. Remove oil filler cap.

3. Insert a clean funnel, with a 100 micron screen incorporated, into the filler neck.

4. Replenish with oil to within 1 quart below MAX mark on dipstick.

5. Check oil filler cap for damaged preformed packing, general condition and locking.

6. Secure oil filler cap.

7. Check for and remedy any oil leaks.

2-101. Servicing Hydraulic Brake System Reservoir.

1. Gain access to brake hydraulic system reservoir. (fig. 2-38).

NOTE

The hydraulic brake system reservoir for the aircraft is located on the right side of the bulkhead in the nose avionics compartment.

2. Remove brake reservoir cap and fill reservoir to washer on dipstick with hydraulic fluid.

3. Install brake reservoir cap.

2-102. Inflating Tires.

Inflate tires as follows:

1. Inflate nose wheel tire to a pressure between 50 and 55 PSI. (For very soft field take-offs, nose wheel tire pressure should be between 30 and 32 PSI.)

2. Inflate main wheel tires to a pressure between 51 and 57 PSI for type A66A (10 ply, RU-21A), between 54 and 60 PSI for type A-53 (10 ply, RU-21A) and between 49 and 55 PSI for 12 ply tires (RU-21A and RU-21D).

2-103. Anti-Icing, Deicing and Defrosting Protection.

The aircraft is protected in subfreezing weather by spraying the surfaces (to be covered with protective covers) with defrosting fluid. Spraying defrosting fluid on aircraft surfaces before installing protective covers will permit protective covers to be removed with a minimum of sticking. To prevent freezing rain and snow from blowing under protective covers and diluting the fluid, insure that protective covers are fitted tightly. As a deicing measure, keep exposed aircraft surface wet with fluid for protection against frost.

NOTE

Do not apply anti-icing, deicing and defrosting fluid on exposed aircraft surfaces if snow is expected. Melting snow will dilute the defrosting fluid and form a slush mixture which will freeze in place and become difficult to remove.

2-104. Anti-Icing, Deicing and Defrosting Treatment.

Use undiluted anti-icing, deicing and defrosting fluid (MIL-A-8243) to treat aircraft surfaces for protection against freezing rain and frost. Spray aircraft surface sufficiently to wet area, but without excessive drainage. A fine spray is recommended to prevent waste. Use diluted, hot fluid to remove ice accumulations.

1. Remove frost or ice accumulations from aircraft surfaces by spraying with diluted anti-icing, deicing, and defrosting fluid mixed in accordance with table 2-8.

2. Spray diluted, hot fluid in a solid stream (not over 15 gallons per minute). Thoroughly saturate aircraft surface and remove loose ice. Keep a sufficient quantity of diluted, hot fluid on aircraft surface coated with ice to prevent liquid layer from freezing. Diluted, hot fluid should be sprayed at a high pressure, but not exceeding 300 PSI.

Table 2-9. Recommended Fluid Dilutions Chart

AMBIENT TEMPERATURE (°F)	PERCENT DEFROSTING FLUID BY VOLUME	PERCENT WATER BY VOLUME	FREEZING POINT OF MIXTURE (°F) (APPROXIMATE)
+30° and above	20	80	+10°
+20°	30	70	0°
+10°	40	60	-15°
0°	45	55	-25°
-10°	50	50	-35°
-20°	55	45	-45°
-30°	60	40	-55°

NOTES: 1. Use anti-icing and deicing fluid (MIL-A-8243).

2. Heat mixture to a temperature of 180° to 200°F (82° to 93°C).

3. When facilities for heating are not available and it is deemed necessary to remove ice accumulations from aircraft surfaces, undiluted defrosting fluid may be used. Spray undiluted defrosting fluid at 15 minute intervals to assure complete coverage. Removal of ice accumulations using undiluted defrosting fluid is expensive and slow.

4. If tires are frozen to ground, use undiluted defrosting fluid to melt ice around tire. Move aircraft as soon as tires are free.

2-105. Application of External Power.

CAUTION

Before connecting the power cables from the external power source to the aircraft, insure that the GPU is not touching the aircraft at any point. Due to the voltage drop in the cables, the two ground systems will be of different potentials. Should they come in contact while the GPU is operating, arcing could occur. Turn off all external power while connecting the power cable to, or removing it from the external power supply receptacle. Be certain that the polarity of the external power source is the same as that of the aircraft before it is connected. GPU shall not exceed 28 VDC.

An external power source is often needed to supply the electric current required to properly ground service the aircraft electrical equipment and to facilitate starting the aircraft's engines. An external DC power receptacle is installed on the outboard side of the right engine nacelle on the RU-21A. There is also an AC receptacle on the outboard side of the left engine nacelle.

2-106. Servicing Oxygen System.

The oxygen system furnishes breathing oxygen to the pilot, copilot and observer. Refer to Section VII for location of oxygen cylinders.

a. Oxygen System Safety Precautions.

WARNING

Keep fire and heat away from oxygen equipment. Do not smoke while working with or near oxygen equipment, and take care not to generate sparks with carelessly handled tools when working on the oxygen system.

1. Keep oxygen regulators, cylinders, gages, valves, fittings, masks, and all other components of the oxygen system free of oil, grease, gasoline, and all other readily combustible substances. The utmost care must be exercised in servicing, handling, and inspecting the oxygen system.

2. Do not allow foreign matter to enter oxygen lines.

3. Never allow electrical equipment to come in contact with the oxygen cylinder.

4. Never use oxygen from a cylinder without first reducing its pressure through a regulator.

b. Replenishing Oxygen System.

1. Remove oxygen access door on outside of aircraft aft of entry door.

2. Remove protective cap on oxygen cylinder filler valve.

3. Attach oxygen hose from oxygen servicing unit to filler valve.

WARNING

If the oxygen cylinder pressure is below 50 PSI, do not attempt to service system. Make an entry on DA Form 2408-13.

4. Insure that supply cylinder shutoff valves on the aircraft are open.

5. Fill system slowly to prevent overheating by adjusting recharging rate with pressure regulating valve on oxygen servicing unit.

6. Close pressure regulating valve on oxygen servicing unit when pressure gage on oxgyen cylinder indicates the pressure obtained from the oxygen system servicing chart (fig. 2-39).

7. Disconnect oxygen hose from oxygen servicing unit and filler valve.

8. Install protective cap on oxygen filler valve.

9. Install oxygen access door

2-107. Ground Handling.

Ground handling covers all the essential information concerning movement and handling of the aircraft while on the ground. The following paragraphs give, in detail, the instructions and precautions necessary to accomplish ground handling functions.

a. General Ground Handling Procedure. Accidents resulting in injury to personnel and damage to equipment can be avoided or minimized by close observance of existing safety standards and recognized ground handling procedures. Carelessness or insufficient knowledge of the aircraft or equipment being handled can be fatal. The applicable technical manuals and pertinent directives should be studied for familiarization with the aircraft, its components, and the ground handling procedures applicable to it, before attempting to accomplish ground handling.

b. Ground Handling Safety Practice. Aircraft equipped with turboprop engines require additional maintenance safety practices. The following list of safety practices should be observed at all times to prevent possible injury to personnel and/or damaged or destroyed aircraft:

1. Keep intake air ducts free of loose articles such as rags, tools, etc.

2. Stay clear of exhaust outlet areas (fig. 8-2).

3. During ground runup, make sure the brakes are firmly set.

4. Keep area fore and aft of propellers clear of maintenance equipment.

5. Do not operate engines with control surfaces in the LOCKED position.

6. Do not attempt towing or taxiing of the aircraft with control surfaces in the LOCKED position.

7. When high winds are present, do not unlock the control surfaces until prepared to properly operate them.

8. Do not operate engines while towing equipment is attached to the aircraft, or while the aircraft is tied down.

9. Check the nose wheel position. Unless it is in the centered position, avoid operating the engines at high power settings.

10. Hold control surfaces in the neutral position when the engines are being operated at high power settings.

11. Keep personnel clear of exhaust danger area.

OXYGEN SYSTEM SERVICING PRESSURE

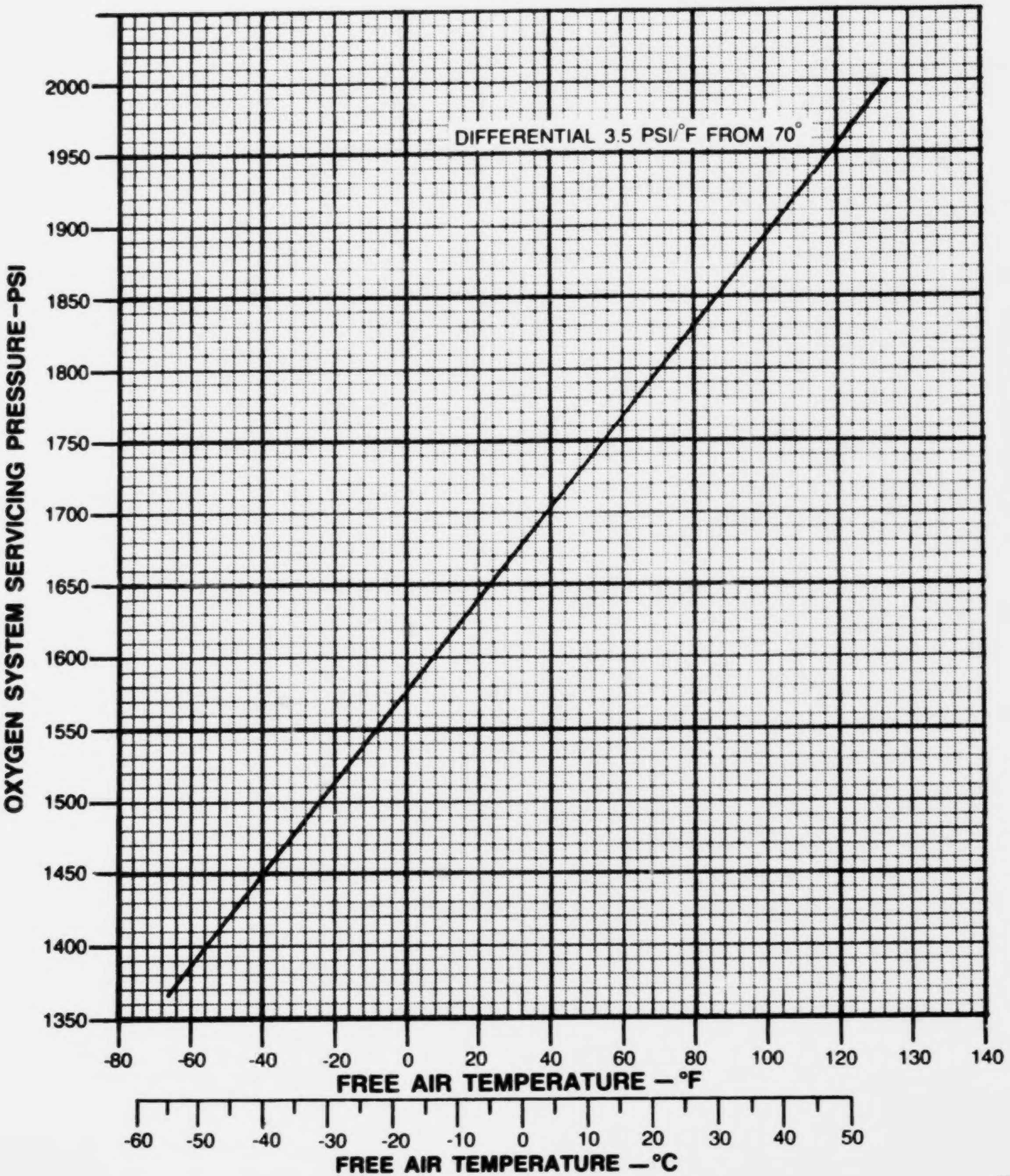

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Figure 2-39. Oxygen System Servicing Pressure

12. When moving the aircraft, do not push on propeller deicing boots. Damage to the heating elements may result.

c. *Moving Aircraft on Ground.* Aircraft on the ground shall be moved in accordance with the following:

(1) Taxiing. Taxiing shall be in accordance with chapter 8.

CAUTION

When the aircraft is being towed, a qualified person must be in the pilot's seat to maintain control by use of the brakes. When towing, do not exceed nose gear turn limits. Avoid short radius turns, and always keep the inside or pivot wheel turning during the operation. Do not tow aircraft with rudder locks installed, as severe damage to the nose steering linkage can result. When moving the aircraft backwards, do not apply the brakes abruptly. Tow the aircraft slowly, avoiding sudden stops, especially over snowy, icy, rough, soggy, or muddy terrain. In arctic climates, the aircraft must be towed by the main gears, as an immense breakaway load, resulting from ice, frozen tires, and stiffened grease in the wheel bearings may damage the nose gear.

CAUTION

Do not tow or taxi aircraft with deflated shock struts.

(2) Towing. Towing lugs are provided on the upper torque knee fitting of the nose strut. When it is necessary to tow the aircraft with a vehicle, use the vehicle tow bar (fig. 2-40). In the event towing lines are necessary, use towing lugs on the main landing gear. Use towing lines long enough to clear nose and/or tail by at least 15 feet. This length is required to prevent the aircraft from overrunning the towing vehicle or fouling the nose gear.

d. *Ground Handling Under Extreme Weather Conditions.* Extreme weather conditions necessitate particular care in ground handling of the aircraft. In hot, dry, sandy, desert conditions, special attention must be devoted to finding a firmly packed parking and towing area. If such areas are not available, steel mats or an equivalent solid base must be provided for these purposes. In wet, swampy areas, care must be taken to avoid bogging down the aircraft. Under cold, icy, arctic conditions, additional mooring is required, and added precautions must be taken to avoid skidding during towing operations. The particular problems to be encountered under adverse weather conditions and the special methods designed to avoid damage to the aircraft are covered by the various phases of the ground handling procedures included in this section of general ground handling instructions. (Refer to TM 55-1500-204-25/1.)

2-108. Parking.

Parking is defined as the normal condition under which the aircraft will be secured while on the ground. This condition may vary from the temporary expedient of setting the parking brake and chocking the wheels to the more elaborate mooring procedures described under Mooring (para. 2-111). The proper steps for securing the aircraft must be based on the time the aircraft will be left unattended, the aircraft weight, the expected wind direction and velocity, and the anticipated availability of ground and air crews for mooring and/or evacuation. When practical head the aircraft into the wind, especially if strong winds are forecast or if it will be necessary to leave the aircraft overnight. Set the parking brake and chock the wheels securely. Following engine shutdown, position and engage the control locks.

NOTE

Cowlings and loose equipment will be suitably secured at all times when left in an unattended condition.

a. The parking brake system for the aircraft incorporates two lever-type valves, one for each wheel brake. Both valves are closed simultaneously by pulling out the parking brake handle. Operate the parking brake as follows:

1. Depress both pilot's toe brakes.

2. Pull parking brake handle out. This will cause the parking brake valves to lock the hydraulic fluid under pressure in the parking brake system, thereby retaining braking action. Release pilot's toe brake pedals.

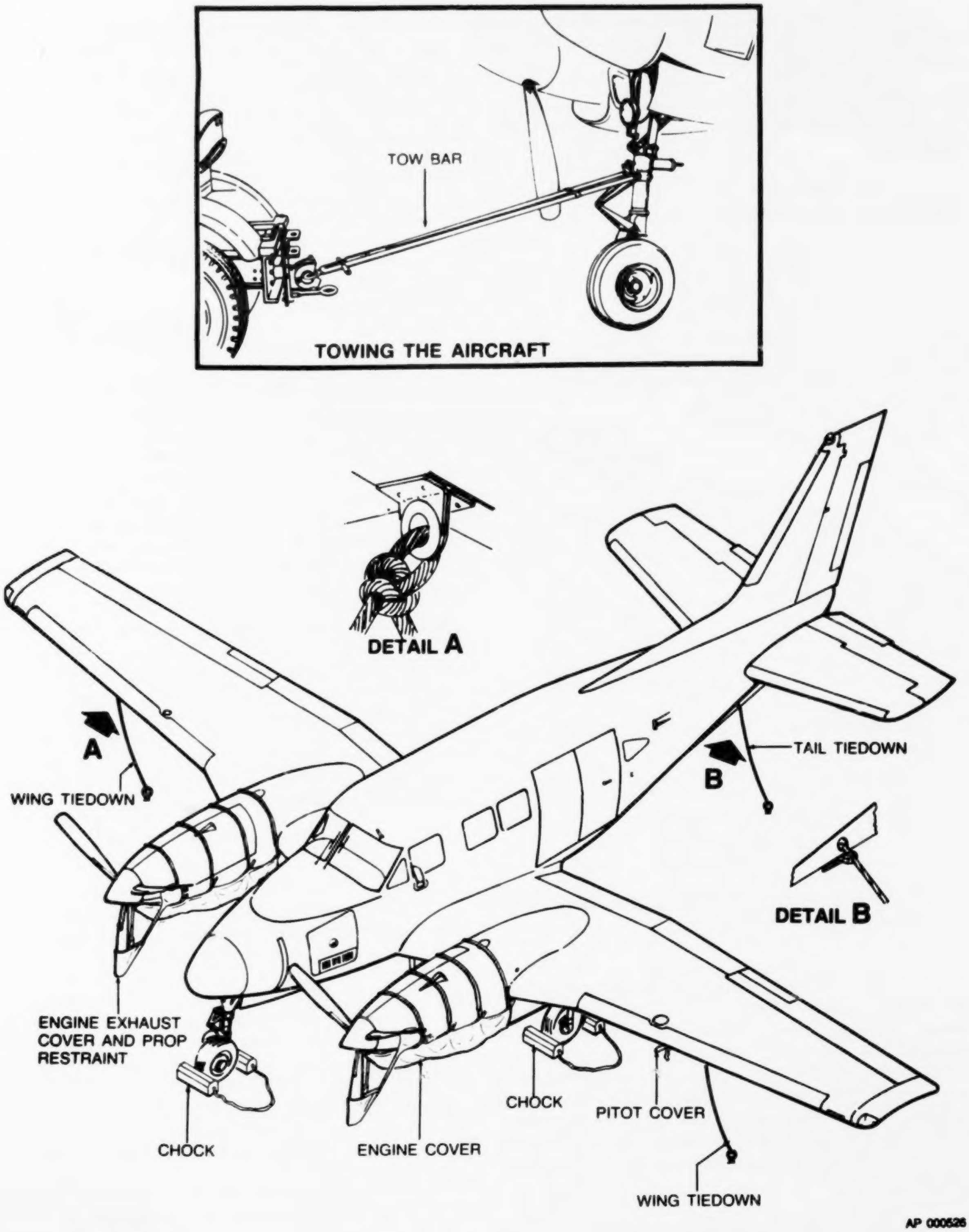


Figure 2-40. Parking, Covers, Ground Handling, and Towing Equipment

NOTE

Parking brake cannot be set by using copilot's brake pedals.

3. Release pilot's toe brake pedals.

CAUTION

Do not set parking brakes when the brakes are hot during freezing ambient temperatures. Allow brakes to cool before setting parking brakes.

4. To release the parking brakes push in on the parking brake handle.

b. The control lock (fig. 2-23, 2-24) holds the engine and propeller control levers in a secure position, and the elevator, rudder, and aileron in neutral position. Install the control locks as follows:

1. With engine and propeller control levers in secure position, slide lock onto control pedestal to prevent operation of levers.

2. Install elevator and aileron lockpin vertically through pilot's control column to lock control wheel.

3. Install rudder lock pin through right hand pilot's rudder pedal; then neutralize and lock pedals together.

4. Reverse steps 1 through 3 above to remove control lock. Store control lock.

2-109. Installation of Protective Covers.

While in transit, the crew will insure that the aircraft is protected during inclement weather. If protective covers (fig. 2-40) are not on board, steps will be taken to procure them from the airfield maintenance facility.

2-110. Mooring.

The aircraft is moored to insure its immovability, protection, and security under various weather conditions. The following paragraphs give, in detail, the instructions for proper mooring of the aircraft.

a. Mooring Provisions. Mooring points (fig. 2-41) are provided beneath the wing, nose, tail and on each main landing gear. General mooring equipment and procedures necessary to moor the aircraft, in addition to the following, are given in TM 55-1500-204-25/1.

1. Use mooring cables of 1/4 inch aircraft cable and clamp (clip-wire rope), chain or rope 3/8 inch or over. Length of the cable or rope will be dependent upon existing circumstances. Allow sufficient slack in ropes, chains, or cable to compensate for tightening action due to moisture absorption of rope or thermal contraction of cable or chain.

CAUTION

Do not use slip knots. Use bowline knots to secure aircraft to mooring stakes.

2. One-piece wheel chocks or wood blocks may be used to chock the main landing gear wheels. They must be equipped with rope or wood cleats to retain them against the wheels.

NOTE

In ice or snow conditions, collapsible ice grip wheel chocks should be used. However, sandbags may be used if collapsible chocks are not available or if parking or mooring the aircraft on steel mats.

b. Mooring Procedures for High Winds. If an aircraft is to remain securely moored during high velocity winds, it is necessary to use the proper size and type of wheel chock. Since the factor of weight is significant in determing adequate mooring provisions, the approximate weight must be known if the aircraft is to be properly secured. During emergencies, knowledge of this information is very useful in selecting the aircraft that should be tied down first, as a heavy aircraft will better stand high winds than an empty aircraft.

CAUTION

Structural damage can occur from high velocity winds; therefore, if at all possible, the aircraft should be moved to a safe weather area when winds above 75 knots are expected.

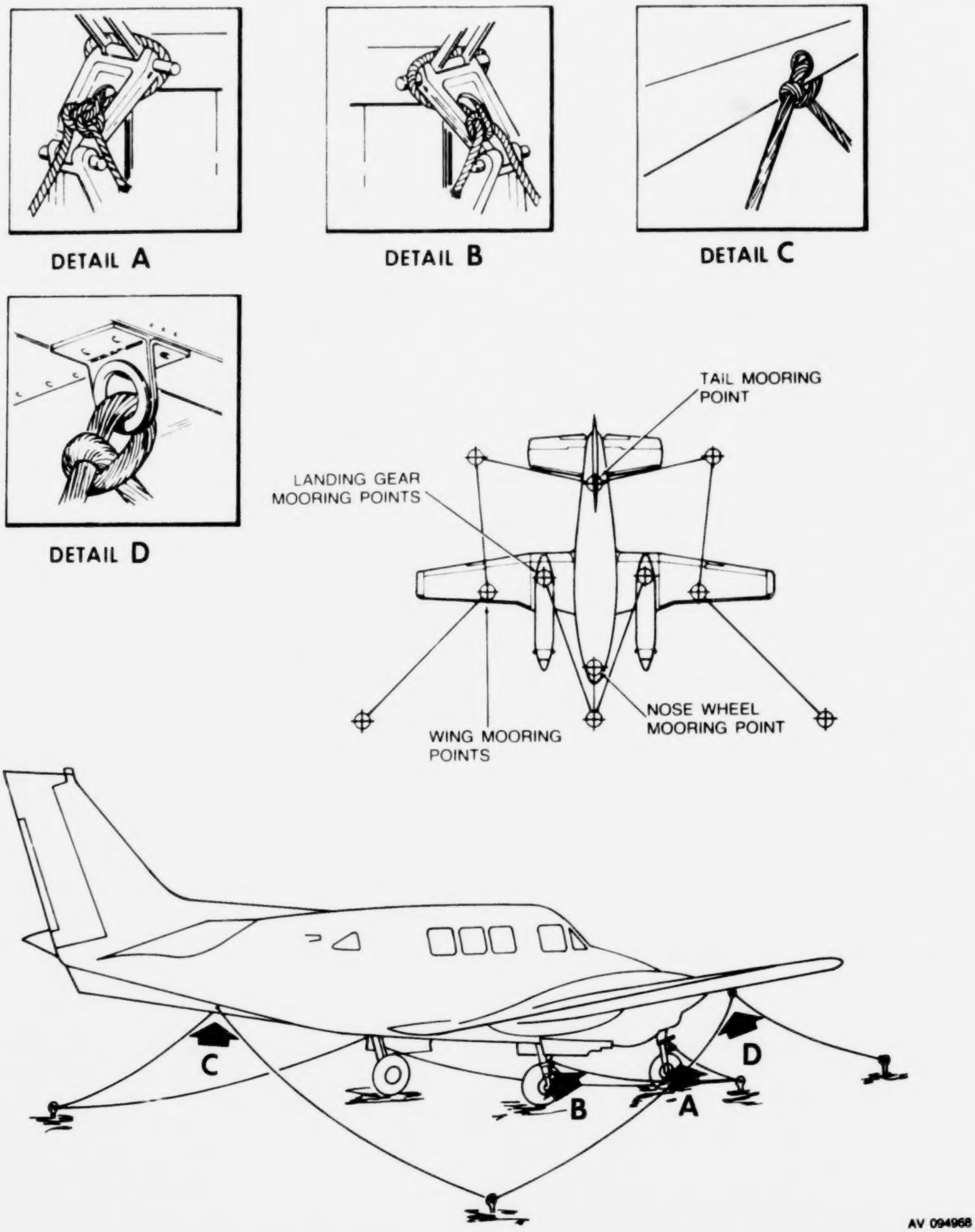


Figure 2-41. Mooring the Aircraft

1. After aircraft is properly located, place nose wheel in centered position. Head aircraft into the wind, or as nearly so as is possible within limits determined by locations of fixed mooring rings. When necessary, a 45 degree variation of direction is considered to be satisfactory. Locate each aircraft at slightly more than wing span distance from all other aircraft. Position nose mooring point approximately 3 to 5 feet downwind from ground mooring anchors.

2. Deflate nose wheel shock strut to within 3/4 inch of its fully deflated position.

3. Fill all fuel tanks to capacity, if time permits.

4. Place wheel chocks fore and aft of main gear wheels and nose wheel. Tie each pair of chocks (wood) together with rope or join together with wooden cleats nailed to chocks on either side of wheels. Tie ice grip chocks together with rope. Use sandbags in lieu of chocks when aircraft is moored on steel mats. Set parking brake as applicable.

5. Accomplish aircraft tiedown by utilizing mooring points (fig. 2-41). Make tiedown with 1/4 inch aircraft cable, using two wire rope clips, or bolts, and a chain tested for a 3000 pound pull. Attach tiedowns so as to remove all slack. (Use a 3/4-inch or larger manila rope if cable or chain tiedown is not available). If rope is used for tiedown, use anti-slip knots, such as bowline knot, rather than slip knots. In the event tiedown rings are not available on hard surfaced areas, move aircraft to an area where portable tiedowns can be used. When anchor kits are not available, use metal stakes or dead-man type anchors, providing they can successfully sustain a minimum pull of 3000 pounds.

6. In event nose position tiedown is considered to be of doubtful security due to existing soil condition, drive additional anchor rods at nose tiedown position. Place padded work stand or other suitable support under the aft fuselage tiedown position and secure.

7. Place control surfaces in locked position and trim tab controls in neutral position. Place wing flaps in up position.

8. The requirements for dust excluders, protective covers, and taping of openings will be left to the discretion of the responsible maintenance officer or the pilot of the transient aircraft (fig. 2-40).

9. Secure propellers to prevent windmilling (fig. 2-40).

10. Disconnect battery.

NOTE

Where typhoon or hurricane conditions exist, it is well to remember that the storm appears to pass two times, each time with a different wind direction. This will necessitate turning the aircraft after the first passing.

11. During typhoon or hurricane wind conditions, mooring security can be further increased by placing sandbags along the wings to break up the aerodynamic flow of air over the wing, thereby reducing the lift being applied against the mooring by the wind.

12. After high winds, inspect aircraft for visible signs of structural damage and for evidence of damage from flying objects. Service nose shock strut and reconnect battery.

CHAPTER 3

AVIONICS

Section I. GENERAL

3-1. Introduction.

This chapter covers the avionics equipment configuration installed in Army RU-21A and RU-21D aircraft. It includes a brief description of the avionics equipment, its technical characteristics, capabilities, and location.

3-2. Avionics Equipment Configuration.

NOTE

Transmission on emergency frequencies (guard channel) shall be restricted to emergencies only.

The avionics configuration of RU-21A and RU-21D aircraft is comprised of three groups of electronic equipment. The communication equipment group consists of the interphone, FM liaison, UHF command, VHF command, and HF command systems. The navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position and to make an approach under Instrument Meteorological Conditions (IMC). The navigation group includes equipment for determining altitude, attitude, position, destination range and bearing, heading reference, groundspeed, and drift angle. The transponder and radar group includes an identification, position and emergency tracking system, a radar system to locate potentially dangerous weather areas and a radar system to differentiate between friendly and unfriendly search radar.

NOTE

All avionics equipment require a 3 minute warm-up period. The weather radar has an automatic time delay of 3 to 4 minutes. The INS will require a period of 3 to 5 minutes for warm-up and alignment, if the heading memory feature has been utilized, or a 12 to 15 minute warm-up period if the heading memory feature has not been utilized, or if the aircraft has been moved prior to completing INS alignment.

3-3. Power Source.

DC power for the avionics equipment is provided from the 28 VDC battery bus, two 375-ampere isolation limiters (right and left feeder), through six 50-ampere circuit breakers located on the copilot's circuit breaker panel, to the various avionics equipment circuit breakers. Two circuit breakers each are placarded HF HIGH POWER, AVIONICS, and INS POWER. AC power for the avionics equipment is supplied by three inverters. The inverters supply 115 volts single-phase AC power when operated by the MAIN INVERTER switch and 115 volts three-phase when operated by the INERTIAL INVERTER switch. The MAIN inverter is wired for single-phase output, only, while the INERTIAL inverter is wired for three-phase output. The STBY MAIN inverter is wired for single and three-phase output as a means to provide a back-up system for either the aircraft inverter system or the INS inverter system. An external DC power supply can be supplied to the aircraft through a receptacle that is provided under the right wing outboard of the nacelle. On RU-21A aircraft, external single-phase AC power can be supplied to the aircraft through a receptacle provided under the left wing outboard of the nacelle.

Section II. COMMUNICATIONS

3-4. Description.

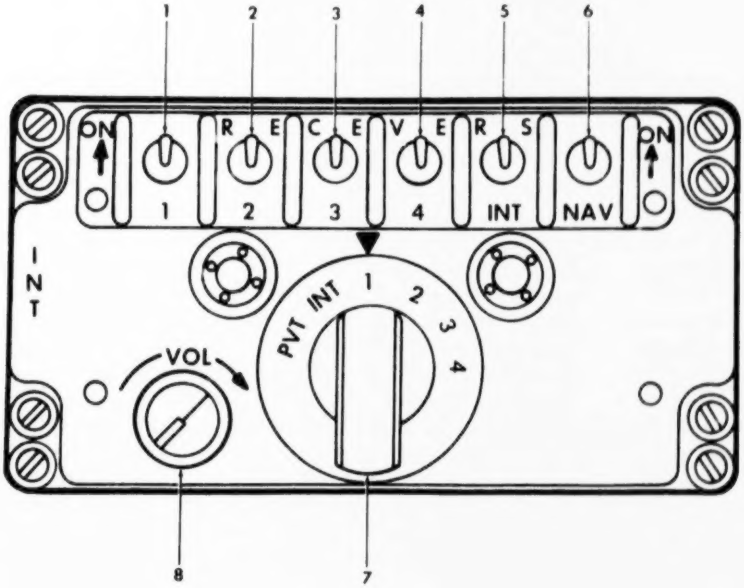
The communication equipment configuration consists of the interphone, FM liaison, UHF command, VHF command, and HF command systems used to provide CW and radio-telephone communications.

3-5. Microphone Switches.

a. Description. The pilot and copilot are each provided with three microphone switches. The pilot's and copilot's microphone switches include a three-position, rocker-type switch, placarded XMIT-INT, located on the outboard grip of each control wheel, a foot-operated switch, placarded MIC, located in front of each seat, and a pushbutton switch in each headset-microphone jack. On the RU-21D, each mission operator is provided with a foot-operated switch and a switch located in the head-set microphone jack. All of these switches are spring-loaded to return to the off position when released.

b. Microphone Switch Functions.

CONTROL	FUNCTION
XMIT-INT switch	
XMIT	Keys the transmitter or interphone facility selected by the transmitter-selector on the respective audio control panel.
INT	Keys the interphone facility regardless of the position of the transmitter-interphone selector.
MIC switch	When pressed, keys the facility regardless of the transmitter-interphone selector on the respective audio control panel.
Headset-microphone jack switch	When pressed, keys the facility selected by the transmitter-interphone selector on the respective audio control panel.



1. RECEIVERS - 1 switch
2. RECEIVERS - 2 switch
3. RECIEVERS - 3 switch
4. RECEIVERS - 4 switch
5. RECEIVERS - INT switch
6. RECEIVERS - NAV switch
7. TRANSMITTER - interphone selector switch
8. VOL - cnt

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Figure 3-1. Audio Control Panel (C-1611/AIC)

3-6. Interphone System.

The interphone system consists of the audio control panels, and audio discriminators.

a. Audio Control Panels (C-1611/AIC). Individual audio control panels (fig. 3-1) are provided for the pilot and copilot. The controls and switches on each panel provide for reception and volume control of interphone, communication, and navigation audio signals. In addition, a choice of transmission over assigned FM, UHF, VHF, or HF command preselected channels is available. Power for the audio control panel is fed through the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers in the copilot's circuit breaker and fuse panel. The unit is protected by 2-ampere AUDIO PILOT, AUDIO COPILOT, and AUDIO CREW (RU-21D) circuit breakers on the right subpanel.

(1) Audio control panel functions (fig. 3-1).

CONTROL	FUNCTION
RECEIVERS-1 switch	ON position applies FM receiver audio to the headset.
RECEIVERS-2 switch	ON position applies UHF receiver audio to the headset.
RECEIVERS-3 switch	ON position (RU-21A) applies VHF receiver audio to the headset. ON position (RU-21D) applies VHF or mission receiver audio to the headset.
RECEIVERS-4 switch	ON position applies HF receiver audio to the headset.
RECEIVERS-INT switch	ON position applies interphone audio to the headset.
RECEIVERS-NAV switch	ON position applies VOR, ADF, TACAN, and marker beacon audio to the headset.
Transmitter-interphone selector	Determines operating mode:
PVT	(RU-21D) Selects private interphone communication between the pilot and copilot only.
INT	Selects interphone communication.
1	Selects pilot's FM transmitter.
2	Selects UHF transmitter.
3	Selects VHF transmitter.
4	Selects HF transmitter.
VOL control	Adjusts volume.

(2) Audio control panel operation.

(a) Turn-on procedure: Audio control panel is on whenever electrical power is applied to the aircraft.

(b) Interphone operation procedure:

1. Transmitter-interphone selector – INT. (On the RU-21D, the PVT position is also available.)

2. Microphone switch – Press (listen for sidetone).

3. Volume control – Adjust sidetone and interphone audio level (approximately half volume).

(c) Navigational aid and receiver monitoring procedure:

1. Receiver switches – As required.

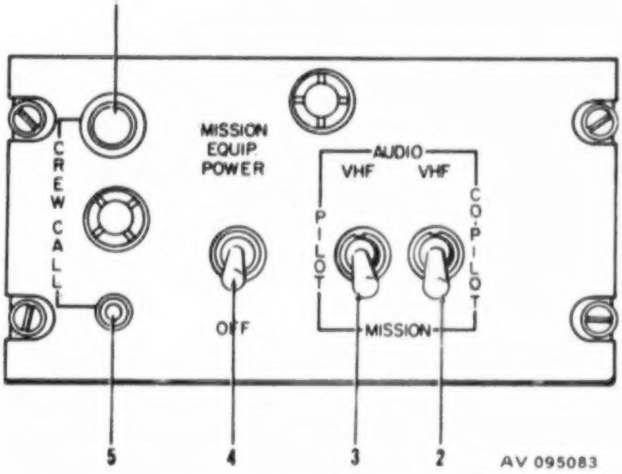
2. Volume control – Do not disturb. Adjust volume control of system being monitored.

(d) Transmitting procedure:

1. Transmitter-interphone selector – As required.

2. Microphone switch – Press (listen for sidetone).

3. Applicable transceiver volume control – Adjust for comfortable audio level.



1. CREW CALL indicator
2. COPILOT AUDIO switch
3. PILOT AUDIO switch
4. MISSION EQUIP POWER switch
5. CREW CALL switch

Figure 3-2. Audio - Power Control Panel (RU-21D)

b. Audio Discriminators. The audio discriminators operate automatically to prevent simultaneous transmission of received secure information on a nonsecure frequency. The audio discriminators have no external control or indicators. The functions of the discriminators are as follows:

(1) Pilot's and copilot's. The pilot's and copilot's audio discriminators perform two functions. One is to disable the FM receiver, RHAW and transponder receivers, interphone and VHF receiver when the UHF, VHF, or HF transmitter is keyed at that respective position. The other function is to filter out weak audio signals to prevent possible crosstalk by induced audio voltage between radio channels.

(2) VHF-FM. The VHF-FM audio discriminator is connected to the audio output of the FM transmitter to provide additional security of audio transmissions by filtering possible crosstalk.

c. Audio-power Control Panel RU-21D The audio-power control panel (fig. 3-2) provides the controls for applying AC and DC power to the mission equipment, for selecting VHF or special equipment receiver audio, and for paging the operators. The audio-power control panel is protected by the 3-ampere SPECIAL AVIONICS DC CONTROL circuit breaker in the copilot's circuit breaker and fuse panel.

(1) Audio-power control panel functions RU-21D (fig. 3-2).

CONTROL	FUNCTION
CREW CALL indicator	Flashes amber while the CREW CALL is being pressed, indicating that the switch and flasher circuit are operative.
COPILOT AUDIO switch	Same as pilot's audio switch.
PILOT AUDIO switch	VHF position applies VHF command receiver audio to the RECEIVERS-3 switch of the pilot's audio control panel. MISSION position applies the selected auxiliary equipment receiver audio to the RECEIVERS-3 switch of the pilot's audio control panel.
MISSION EQUIP POWER switch	On (up) position completes the first step in the procedure for applying DC power to the mission equipment. (Refer to chapter 3 for the remainder of the procedure.) Setting the switch to OFF will remove all power from the mission equipment regardless of other control settings.

CREW CALL switch	Flashes the crew call indicators on the mission equipment console. When released, the crew call circuit is disabled.

(2) Audio-power control panel operation. (Refer to para. 3-6.)

3-7. Secure-Nonsecure Indicator System. RU-21D

a. Description. The secure-nonsecure indicator system consists of a switching circuit in the audio system and secure-nonsecure indicator lights located at the pilot's and copilot's stations (fig. 2-36). The lights will illuminate automatically whenever the cipher mode is selected on a voice security control-indicator, and/or whenever the HF data mode is selected to inform the operator of the security status of the transmitter being used. The indicator system is designed so that all secure or nonsecure lights will illuminate simultaneously. Power for the secure-nonsecure indicator system is fed through the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers on the copilot's circuit breaker panel. The unit is protected by the 10-ampere RADIO RELAY circuit breaker in the right subpanel.

b. Secure-Nonsecure Indicator System Operation RU-21D The secure-nonsecure indicator system operates as follows:

(1) The secure indicators will illuminate green when:

(a) The PLAIN/CIPHER switch on either voice security control-indicator is set to the CIPHER position.

(b) The mode switch on the HF control panel is set to the DATA position.

(2) The nonsecure indicators will illuminate amber when:

(a) The UHF or VHF transmitter is keyed.

(b) The HF SSB-AM transmitter is keyed in the AM, LSB or USB mode.

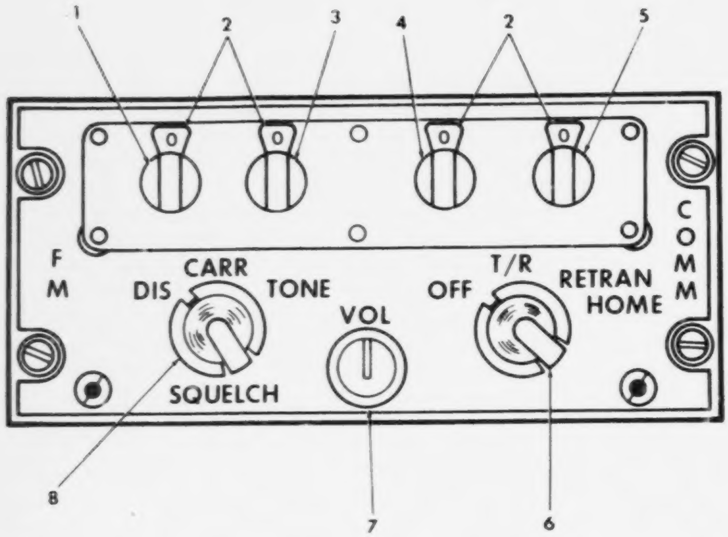
(c) Either FM transmitter is keyed with the applicable voice security system in the plain mode.

3-8. FM Liaison Set (AN/ARC-131).

The FM liaison set (fig. 3-3) is a radio transceiver which provides two-way frequency modulated (FM) communications in the 30.00 to 75.95 MHz range for a distance of approximately 50 miles. On the RU-21A, one FM liaison set is installed for the pilot and copilot. On the RU-21D, two FM liaison sets are installed; one for the pilot and copilot, and one for the mission operators. The pilot's liaison set is used for voice communications and FM homing. The RU-21D mission operator's liaison set is used for voice communications only. The audio output of each FM liaison set receiver is applied to the respective audio control panel where it is made available to the headsets. Power for the FM liaison set is fed through the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers in the copilot's circuit breaker and fuse panel. The pilot's FM liaison set is protected by the 15-ampere VHF-FM circuit breaker on the right subpanel, while the RU-21D mission operator's FM liaison set is protected by the 10-ampere circuit breaker on the AC & DC PWR DISTR JCT BOX in the mission console.

a. FM Control Panel Functions (fig. 3-3).

CONTROL	FUNCTION
Megahertz selector	Tunes transceiver in 10-MHz and 1-MHz steps as indicated by the first two digits of the frequency indicator.
Frequency indicator	Indicates frequency to which transceiver is tuned.
Kilohertz selector	Tunes transceiver in 100-kHz and 50-kHz steps as indicated by last two digits of the frequency indicator.
Mode selector	Determines operating mode:
OFF	Turns set off.
T/R	Provides for transceiver operation of frequency displayed on frequency indicator.
RETRAN	Not used in this installation.
HOME	Provides for operation in the homing mode. May also be operated as a transceiver on channels indicated on frequency indicator.



1. Ten megahertz selector
2. Frequency indicators
3. One megahertz selector
4. One hundred kilohertz selector
5. Ten kilohertz selector
6. Mode switch
7. VOL control
8. SQUELCH switch

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Figure 3-3. FM Control Panel (AN/ARC-131)

NOTE

The VOL control is inoperative when the voice security (CIPHONY) control-indicator is installed.

VOL control	Adjusts volume.
SQUELCH switch	
DIS	Disables receiver squelch circuit.
CARR	Activates receiver squelch circuits.
TONE	Not used in this installation.

b. FM Liaison Set Operation. Refer to Voice Security System (para. 3-9, 3-10).

3-9. Voice Security System (TSEC/KY-28).

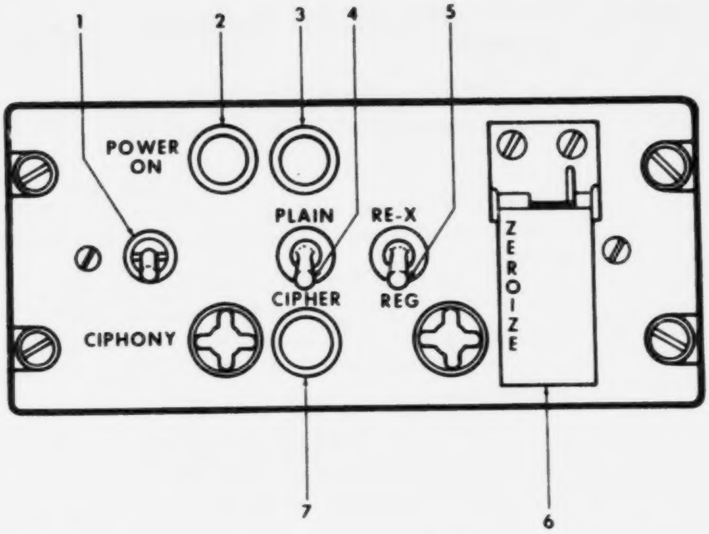
NOTE

Voice security system, TSEC/KY-58 may be installed in lieu of voice security system, TSEC/KY-28.

The voice security systems (fig. 3-4) are used in conjunction with the FM liaison set to provide secure (ciphered), two-way voice communications. On the RU-21A, one voice security system is installed for the pilot and copilot. On the RU-21D, two voice security systems are installed; one for the pilot and copilot, and one for the mission operators. Power for the voice security system is fed through the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers on the copilot's circuit breaker and fuse panel. The pilot's voice security system is protected by the 15-ampere VHF-FM circuit breaker on the right subpanel, while the RU-21D mission operator's voice security system is protected by the 10-ampere ARC-131 circuit breaker on the AC & DC PWR DISTR JCT BOX in the mission console.

a. Voice Security Control-Indicator Functions (fig. 3-4).

CONTROL	FUNCTION
POWER ON switch	Turns set on or off.



1. POWER-ON switch
2. POWER-ON indicator
3. PLAIN indicator
4. PLAIN-CIPHER switch
5. RE-X-REG switch
6. ZEROIZE switch
7. CIPHER indicator

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Figure 3-4. Voice Security Control-Indicator (C-8157/ARC)

NOTE

Switch must be in the ON position for FM liaison operations in either the plain or ciphered mode.

CONTROL	FUNCTION
POWER ON indicator	Illuminates when the POWER ON switch is placed in the on (up) position.
PLAIN indicator	Illuminates when the PLAIN/CIPHER switch is in the PLAIN position.
PLAIN/CIPHER switch	
PLAIN	Permits unciphered communications on the FM liaison set.
CIPHER	Permits ciphered communications on the FM liaison set.
RE-X/REG switch	
RE-X	Permits retransmission of ciphered communications at a distant location.
REG	Permits normal cipher or plain communications.

NOTE

Do not place the ZEROIZE switch in the ON position unless a crash or capture is imminent.

ZEROIZE switch	Normally in OFF position. Placed in ON position during emergency situations to neutralize and make inoperative the associated cipher equipment.
CIPHER indicator	Illuminates when the PLAIN/CIPHER switch is in the CIPHER position.

b. FM Liaison Set and Voice Security System Operation.

NOTE

The audio discriminators will automatically interrupt the FM receiver audio at a given position whenever the UHF, VHF, or HF transmitter is keyed from that position.

(1) Turn-on procedure: POWER ON switch (CIPHONY control-indicator, fig. 3-4) – ON.

NOTE

The POWER ON switch must be in the ON position, regardless of the mode of operation, whenever the voice security (CIPHONY) KY-28 is installed in the aircraft.

(2) Receiver operating procedure:

1. SQUELCH switch (FM control panel, fig. 3-3) – As required.

2. Mode selector (FM control panel) – T/R.

NOTE

The VOL control on the FM (FM COMM) control panel is inoperative when the CIPHONY control indicator is installed in the aircraft.

3. Frequency selectors (FM COMM control panel) – As required.

(3) Transmit operating procedure (PLAIN):

1. Transmitter-interphone selector (audio control panel, fig. 3-1) – No. 1 position.

2. PLAIN/CIPHER switch (CIPHONY control-indicator) – PLAIN

3. Microphone switch – Press.

(4) Transmit operating procedure (CIPHER):

1. Transmitter-interphone selector (audio control panel) – No. 1 position.

2. PLAIN/CIPHER switch (CIPHONY control-indicator) – CIPHER. (CIPHER indicator will be on as long as switch is in CIPHER position.)

3. RE-X/REG switch (CIPHONY control-indicator) – As required. (RE-X position only if distant station is using retransmitting equipment.)

4. Microphone switch – Press momentarily (interrupted tone from voice security unit should no longer be heard.)

NOTE

No traffic will be passed if the interrupted tone is still heard from pressing and releasing the microphone switch.

5. Microphone switch – Press (do not talk). Wait until beep is heard, then speak into microphone.

(5) Homing operating procedure:

CAUTION

In the RU-21D, do not operate the FM liaison set in the homing mode while the mission operators are using their FM liaison set. Their transmission could damage the FM receiver, and may also cause erroneous steering signals.

NOTE

Accuracy of the FM liaison set has been verified on the following frequencies only: 32.00, 34.50, 38.90, and 39.50 MHz.

1. Mode selector (FM COMM control panel) – HOME.

2. Frequency selectors (FM COMM control panel) – Select.

3. VOL control (FM COMM control panel) – As required.

4. Pilot's or copilot's COURSE IND switch – HOME. (fig. 2-36 or 2-37)

NOTE

FM homing steering signals can be displayed on only one course indicator-selector at a time.

5. Course deviation indicator (pilot's or copilot's course indicator-selector, figure 3-9 or 3-10) – Read lateral deviation from homing course.

6. Glideslope indicator (pilot's or copilot's course indicator-selector). Read relative signal strength. (Indicator deflects toward the bottom for a weak signal and moves toward the center position as signal strength increases.)

(6) Shutdown procedure:

1. Mode selector (FM COMM control panel) – OFF.

2. POWER ON switch (CIPHONY control-indicator) – OFF.

3-10. Voice Security System (TSEC/KY-58).

NOTE

Voice security system, TSEC/KY-28 may be installed in lieu of voice security system, TSEC/KY-58.

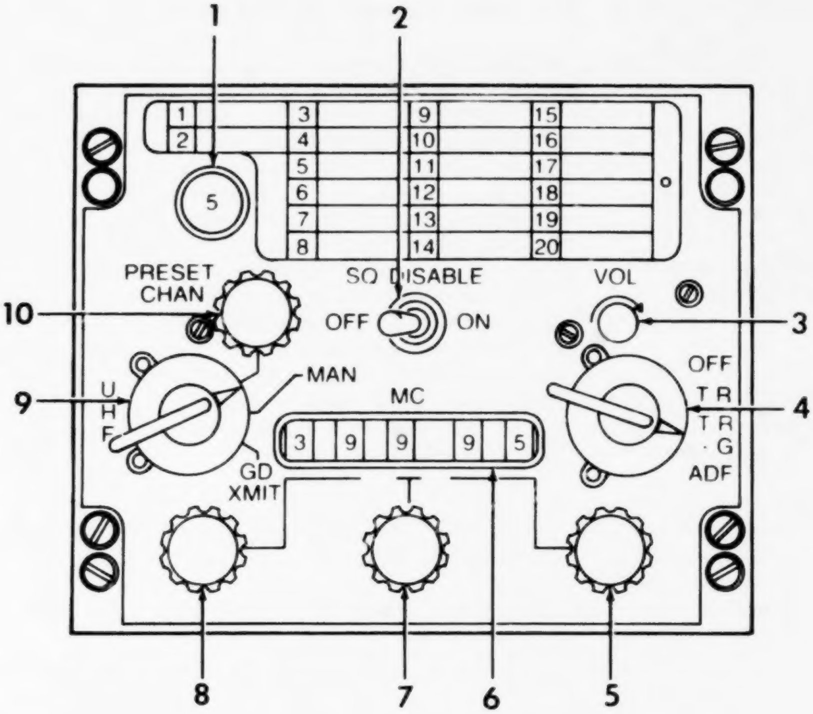
The voice security system is used in conjunction with the FM liaison set to provide secure (ciphered), two-way voice communications. Power for the voice security system is fed through the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers on the copilot's circuit breaker and fuse panel. The voice security system is protected by the 15-ampere VHF-FM circuit breaker on the right subpanel. For operating instructions, refer to TM 11-5810-262-OP and TM 11-5810-262-20.

3-11. UHF Command Set (AN/ARC-51BX).

The UHF command set provides two-way amplitude modulated (AM) voice communication within the frequency range of 225.0 to 399.95 MHz for a distance range of approximately 50 miles line-of-sight. Channel selection is spaced at 50 kHz intervals. Additionally, a separate receiver is incorporated to provide monitoring capability for the UHF guard frequency (243.0 MHz). The audio output of the UHF set is applied to the audio control panel where it is made available to the headsets. The UHF command set is protected by the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers on the copilot's circuit breaker and fuse panel and the 15-ampere UHF circuit breaker on the right subpanel. Figure 3-5 illustrates the UHF command set control panel.

a. UHF Command Set Control Panel Switch Functions (fig. 3-5).

CONTROL	FUNCTION
Preset channel indicator	Indicates the preset channel in use when the mode selector is in the PRESET CHAN position.
SQ DISABLE switch	Turns squelch circuit on or off.
VOL control	Adjusts volume.
Function switch	Selects type of operation and turns set off.
Manual frequency selector	Selects the operating frequency when the mode selector is in the MAN position.
Frequency indicator	Indicates the operating frequency of the UHF receiver and transmitter when the mode selector is in the MAN position.
Mode selector	Determines operating mode:
PRESET CHAN	Permits selection of one of 20 preset channels.
MAN	Permits frequency selection by means of manual frequency selector controls.
GD XMIT	Automatically tunes to the guard channel frequency.



1. Preset Channel indicator
2. SQ DISABLE switch
3. VOL control
4. Function switch
5. Decimal MC selector
6. MC indicator
7. One MC selector
8. Ten MC selector
9. Tuning mode switch
10. PRESET CHAN selector

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Figure 3-5. UHF control panel (AN/ARC-51BX)

PRESET CHAN selector	Selects the desired preset channel when the mode selector is in the PRESET CHAN position.

b. UHF Command Set Operation.

(1) Turn-on procedure: Function switch (UHF control panel) - T/R + G.

(2) Receiver operating procedure:

1. Mode selector - As required.

2. Frequency - Select required frequency using either preset channel control or manual frequency selector.

NOTE

The PRESET CHAN selector and manual frequency selectors are inoperative when the mode selector is set to GD XMIT position.

3. Volume - Adjust.

NOTE

To adjust volume when audio is not being received, turn squelch disable switch ON, adjust volume for comfortable noise level, then turn squelch disable switch OFF.

4. Squelch - As required.

(3) Transmitter operating procedure:

1. Transmitter-interphone selector (audio control panel, fig. 3-1) - No. 2 position.

2. Microphone switch - Press. (On RU-21D, NON-SECURE lights will illuminate while transmitter is being keyed).

(4) Shutdown procedure: Function switch - OFF.

c. UHF Command Set Emergency Operation.

NOTE

Transmission on emergency frequencies (guard channel) shall be restricted to emergencies only. An emergency frequency of 121.500 MHz is also available on the VHF command radio set.

1. Transmitter-interphone selector (audio control panel, fig. 3-1) - No. 2 position.

2. Mode selector (UHF control panel) - GD XMIT.

NOTE

The PRESET CHAN selector and frequency selectors are all inoperative when the mode selector is set to GD XMIT position. The receiver-transmitter will be set to 243.00 MHz (emergency frequency).

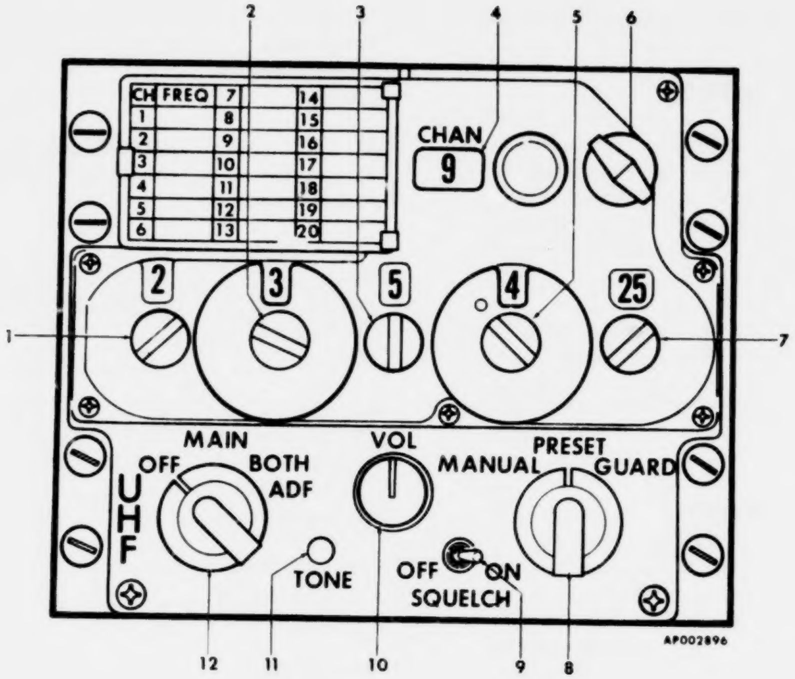
3. Microphone switch - Press.

3-12. UHF Command Set (AN/ARC-164).

The UHF command set (fig. 3-6) provides two-way amplitude modulated (AM) voice communication within the frequency range of 225.000 to 399.975 MHz for a distance range of approximately 50 miles line-of-sight. Channel selection is spaced at 0.025 MHz intervals. Additionally, a separate receiver is incorporated to provide monitoring capability for the UHF guard frequency (243.0 MHz). The audio output of the UHF set is applied to the audio control panel where it is made available to the headsets. Power for the UHF command set is fed through the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers on the copilot's circuit breaker and fuse panel. The unit is protected by the 15-ampere UHF circuit breaker on the right subpanel.

a. UHF Command Set Control Panel Functions:

CONTROL	FUNCTION
Manual Frequency Selector switch (hundreds)	Selects hundreds digit of frequency (either 2 or 3) in MHz.
Manual Frequency Selector switch (tens)	Selects tens digit of frequency (0 through 9) in MHz.
Manual Frequency Selector switch (units)	Selects units digit of frequency (0 through 9) in MHz.
Manual Frequency Selector switch (tenths)	Selects tenths digit of frequency (0 through 9) in MHz.
Manual Frequency Selector switch (hundredths and thousandths)	Selects hundredths and thousandths digit of frequency (00, 25, 50, or 75) in MHz.
Preset Channel Selector switch	Selects one of 20 preset channels.
MANUAL-PRESET-GUARD SWITCH	Selects method of frequency selection:
MANUAL	Any one of 7,000 frequencies is manually selected using the five frequency selector switches.
PRESET	Frequency is selected using the preset channel selector switch for selecting any one of 20 preset channels.
GUARD	The main receiver and transmitter are automatically tuned to the guard frequency and the guard receiver is disabled.
SQUELCH ON-OFF switch	Turns on or off squelch circuit of main receiver.
VOL Control	Adjusts volume.
TONE switch	Selects transmission of a 1,020 Hz tone on the selected frequency.
Function switch	Selects operating function:
OFF	Shuts down equipment.
MAIN	Selects main receiver and transmitter.



1. Manual frequency (100-MHz) selector-indicator
2. Manual frequency (10-MHz) selector-indicator
3. Manual frequency (1-MHz) selector-indicator
4. CHAN indicator
5. Manual frequency (100 kHz) selector-indicator
6. Preset channel selector
7. Manual frequency (10 and 1-kHz) selector-indicator
8. Mode selector
9. SQUELCH switch
10. VOL control
11. TONE pushbutton
12. Function switch

Figure 3-6. UHF Command Set (AN/ARC-164)

BOTH	Selects main receiver, transmitter, and guard receiver.
ADF	Selects ADF or homing system (if installed) and main receiver.

b. UHF Command Set Operation.

(1) Turn on procedure: Function selector switch (UHF control panel) – BOTH.

(2) Receiver operating procedure.

1. Function selector switch – As required.

2. Frequency – Select required frequency using either preset channel control or manual frequency selector controls.

NOTE

The PRESET channel selector and manual frequency selectors are inoperative when the MANUAL-PRESET-GUARD switch is set to GUARD.

3. Volume – Adjust.

4. Squelch – As required.

(3) Transmitter operating procedure:

1. Transmitter – Interphone selector (audio control panel, fig. 3-1) – No. 2 position.

2. Microphone switch – Press.

(4) Shutdown procedure: Function selector switch (UHF control panel) – OFF.

c. *UHF Command Set Emergency Operation.*

NOTE

Transmission on emergency frequencies (guard channel) shall be restricted to emergencies only. An emergency frequency of 121.500 MHz is also available on the VHF command radio set.

1. Transmitter-interphone selector (audio control panel, fig. 3-1) – No. 2 position.

2. Mode selector switch (UHF control panel) – GUARD.

3. Microphone switch – Press.

3-13. VHF Command Set (AN/ARC-134).

The VHF command set (fig. 3-6) is a line-of-sight radio transceiver which provides transmission and reception of amplitude-modulated signals in the very high frequency range of 116.000 to 149.975 MHz for a distance range of approximately 50 miles. Power for the VHF command set is fed through the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers on the copilot's circuit breaker and fuse panel. The unit is protected by the 15-ampere VHF circuit breaker on the right subpanel.

a. *VHF Command Set Control Panel Functions (fig. 3-7).*

CONTROL	FUNCTION
Frequency indicator	Indicates the operating frequency.
COMM TEST switch	Disables VHF receiver squelch circuits to permit reception of low-level communication signals or a test for receiver audio.
VOL control	Adjusts volume.
Frequency selector	Selects the operating frequency.
PWR switch	Turns set on or off.

b. *VHF Command Set Operation.*

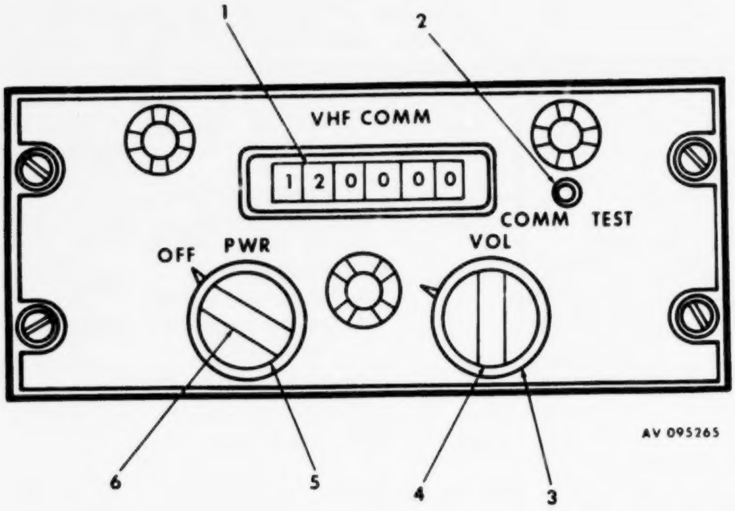
(1) Turn-on procedure: Power switch – PWR.

(2) Receiver operating procedure:

1. Pilot and/or copilot AUDIO/MISSION switch (RU-21D) (audio power control panel, fig. 3-2) – VHF.

2. Frequency selector – Select.

3. VOL control – As required.



1. VHF-COMM frequency indicator
2. COMM-TEST switch
3. VOL control
4. Decimal megahertz selector
5. Power switch
6. Megahertz selector

Figure 3-7. VHF Control Panel (AN/ARC-134)

(3) *Transmitter operating procedure:*

1. Transmitter-interphone selector (audio control panel, fig. 3-1) – No. 3 position.

2. Microphone switch – Press. (On the RU-21D, the NONSECURE lights will illuminate while the transmitter is being keyed.)

(4) *Shutdown procedure:* Power switch – OFF.

c. *VHF Command Set Emergency Operation.*

NOTE

Transmission on emergency frequency (121.500 or 243.000 MHz) shall be restricted to emergencies only.

1. Transmitter-interphone selector (audio control panel, fig. 3-1) – No. 3 position.

2. Frequency selector (VHF control panel) – 121.500 MHz (emergency frequency).

3. Microphone switch – Press.

3-14. HF Command Set (AN/ARC-102).

The HF command set (fig. 3-7) provides long-range voice communications within the frequency range of 2.000 to 29.999 MHz. The HF command set employs either standard amplitude-modulation (AM), lower sideband (LSB) modulation, or upper sideband (USB) modulation. The distance range of the HF command set is approximately 2,500 miles, and varies with atmospheric conditions. Power for the HF command set is fed through the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers. The unit is protected by the 10-ampere HF LO circuit breaker on the right subpanel and the 50-ampere HF HIGH POWER No. 1 and HF HIGH POWER No. 2 circuit breakers on the copilot's circuit breaker and fuse panel.

a. *HF Command Set Control Panel Functions (fig. 3-7).*

CONTROL	FUNCTION
Frequency selector	Selects the operating frequency.
FREQ indicator	Indicates operating frequency.
Mode selector	Determines operating mode:
OFF	Turns set off.
USB	Selects upper sideband modulation.
LSB	Selects lower sideband modulation.
AM	Selects amplitude modulation.

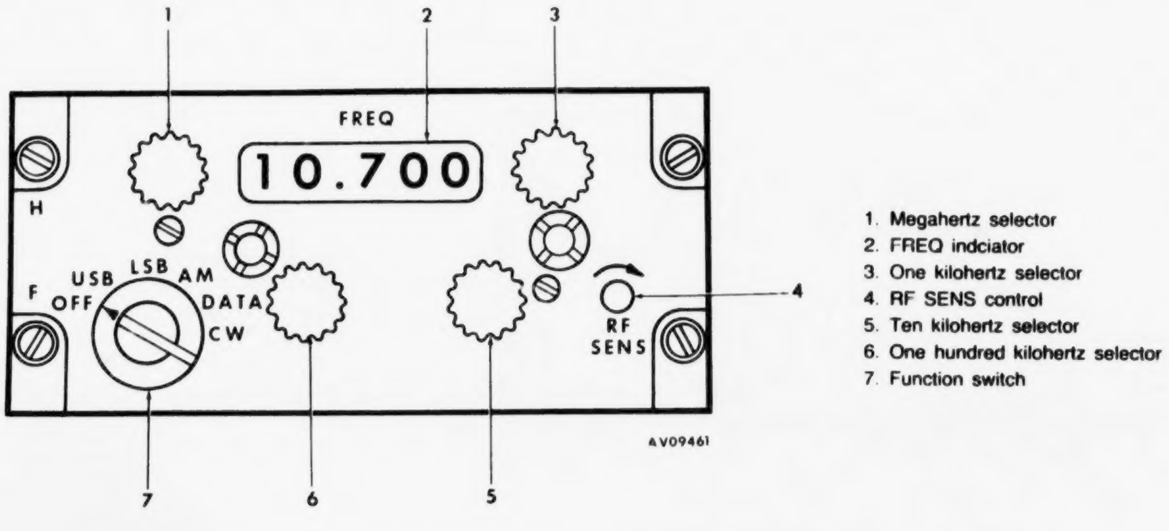


Figure 3-8. HF Control Panel (AN/ARC-102)

DATA (RU-21D)	Used with mission equipment for data link.
DATA (RU-21A)	Not used in this installation.
CW	Upper sideband transmissions are modulated with a 1000 Hz tone.
RF SENS control	Adjusts volume.

b. HF Command Set Operation.

(1) Turn-on procedure: Mode selector – As required.

(2) Receiver operating procedure:

1. Frequency selector – Select.

2. RF SENS control – Adjust for barely audible background noise.

(3) Transmit operating procedure:

1. Transmitter-interphone selector (audio control panel, fig. 3-1) – No. 4 position.

2. Microphone switch – Press.

(4) Shutdown procedure: Mode selector – OFF.

Section III. NAVIGATION

3-15. Description.

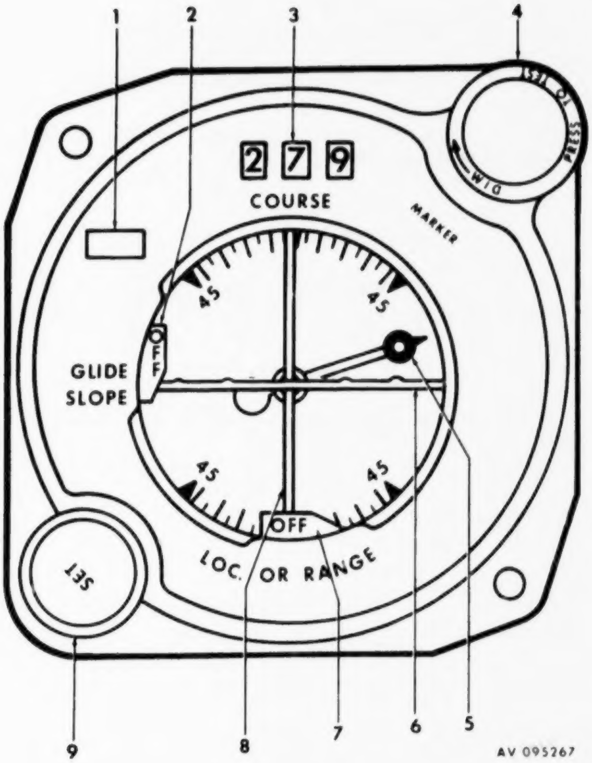
The overall navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position and to make an approach under Instrument Meteorological Conditions (IMC). The navigation configuration includes equipment for determining altitude, attitude, position, destination range and bearing, heading reference, groundspeed, and drift angle.

3-16. Course Indicator-Selectors.

The course indicator-selectors (fig. 3-9 and 3-10) provide course information for the FM homing, TACAN, VOR, and INS facilities. They also provide course and glideslope information for the ILS. The course indicator-selectors are protected by the 2-ampere GYRO COMPASS circuit breaker on the copilot's circuit breaker and fuse panel.

a. Pilot's Course Indicator-Selector (ID-387/ARN or ID-351B/ARN) Functions (fig. 3-9).

CONTROL	FUNCTION
TO-FROM indicator	Indicates whether the course selected is toward, or away from, the selected station when the pilot's COURSE IND switch is in the VOR or TAC position.
OFF flags	Indicate navigation signals are unreliable or loss of power in aircraft navigation system.
COURSE indicator	Indicates the selected magnetic course to or from to TACAN facility when the COURSE IND switch is in the TAC position.
MARKER beacon indicator	Illuminates when the aircraft passes over a marker beacon station.
Heading pointer	Indicates difference between actual aircraft magnetic heading and the selected TACAN course.
GLIDESLOPE indicator	Indicates vertical position of the aircraft relative to the glideslope signal when pilot's COURSE IND switch is in any position except HOME. When pilot's COURSE IND switch is in HOME position, indicates relative strength of received FM signal.
Course deviation indicator	Indicates lateral course deviation during FM homing, TACAN, or VOR/Localizer operations. Also indicates the deviations from computed track in INS direct or intercept modes.
SET control	Controls course indicator to establish the selected magnetic course to or from the TACAN facility.

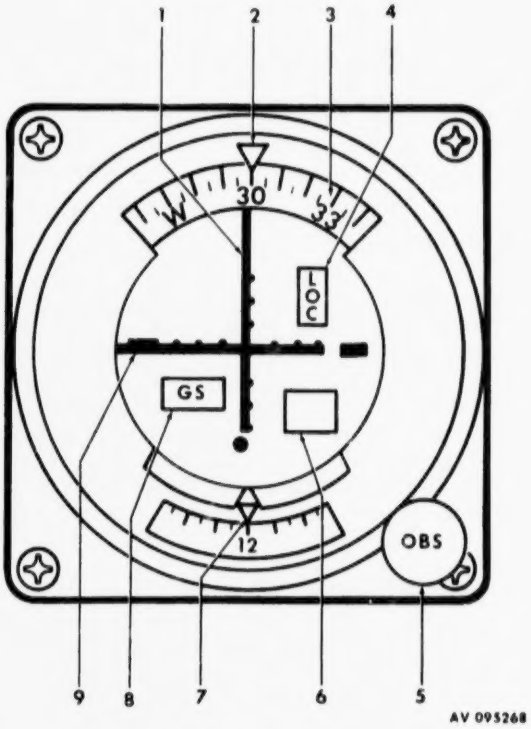


1. TO-FROM indicator
2. GLIDESLOPE OFF flag
3. COURSE indicator
4. MARKER beacon indicator
5. Heading pointer ("doughnut needle")
6. GLIDESLOPE indicator
7. LOC. or RANGE OFF flag
8. Course deviation indicator
9. SET control (course selector knob)

Figure 3-9. Pilot's Course Indicator-Selector (ID-387/ARN)

b. Copilot's Course Indicator-Selector (ID-1347C/ARN) Functions (fig 3-10).

Course index	Indicates the desired magnetic course to or from the selected VOR station when the COURSE IND switch is in the VOR position.
Course indicator dial	Used to establish the desired VOR magnetic course.
OFF flags	Indicate navigation signals are unreliable, or loss of power in aircraft navigation system.
TO-FROM indicator	Indicates whether the selected course is toward or away from, the received station when the copilot's COURSE IND switch is in the TAC or VOR position.
OBS control	Used to rotate the course indicator dial to establish the required magnetic course to the VOR facility.



1. Course deviation indicator
2. Course index
3. Course Card
4. VOR/LOC flag
5. OBS control
6. TO-FROM indicator
7. Reciprocal course index
8. GS flag
9. Glideslope indicator

Figure 3-10. Copilot's Course Indicator-Selector (IC-1347C/ARN)

Reciprocal course index	Indicates a course which is 180° from the selected course.
Glideslope indicator	Indicates vertical position of the aircraft relative to the glideslope signal when the copilot's COURSE IND switch is in any position except HOME. Indicates relative strength of received FM signal when copilot's COURSE IND switch is in HOME position.
Course deviation indicator	Indicates lateral course deviation during VOR, FM homing, TACAN, or localizer operations, also indicates deviations from computed INS direct or intercept courses.

3-17. Course Indicator Switches.

a. Description. The navigation signal displayed by the course indicator-selectors is selected by the pilot's or copilot's course indicator switch, placarded COURSE IND switch on the instrument panel.

b. Course Indicator Functions (fig. 2-36 or 2-37).

CONTROL	FUNCTION
COURSE IND switches	
TAC	Applies signals from the TACAN transceiver to the course deviation indicator.
VOR	Applies signals from the VOR/ILS receiver to the course deviation indicator.
HOME	Applies signals from the FM receiver to the course deviation indicator. This position also applies the FM homing signal strength, from the FM receiver, to the glideslope deviation indicator of the respective indicator.

NOTE

FM homing signals cannot be presented on both the pilot's and copilot's indicators simultaneously. The pilot's indicator takes priority. If the pilot has the FM homing or INS bearing signals on his indicator, the copilot cannot obtain the homing signal until the pilot moves his COURSE IND switch to another position. When the copilot has his switch in the HOME position, the pilot sets his COURSE IND switch to the HOME position, the homing signals will transfer from the copilot's indicator to the pilot's indicator.

INS (RU-21A)	Applies INS direct or intercept steering signal from the INS computer to the pilot's course indicator-selector.
A/P INS DIR (RU-21A)	Applies INS intercept steering signal from the INS computer to the copilot's course indicator-selector.

NOTE

In RU-21A aircraft, when the copilot's switch is set to the A/P INS DIR position, the INS computer will compute a straight line course to the desired destination (if it is operating in INS navigation mode) and the lateral steering signals for this course will be applied to the course deviation indicator deflection circuits of the copilot's indicator. When the pilot's switch is set to the INS position, lateral steering signals for an INS direct or intercept course, depending on the position of the copilot's switch, will be applied to the course deviation indicator deflection circuits of the pilot's indicator. Glideslope steering signals will be applied to the horizontal pointer deflection circuits of both indicators whenever the marker beacon-glideslope receiver is operating, except when the respective COURSE IND switch is in the HOME position.

A/P INS INTCP (RU-21A)	Applies INS intercept steering signal from the INS computer to the copilot's course indicator-selector.

NOTE

When the copilot's switch is set to the A/P INS INTCP position, the INS computer will compute an intercept course to the desired destination (if it is operating in the INS navigation mode), and the lateral steering signals for the course deviation indicator deflection circuits of the copilot's indicator.

INS (RU-21D)	Applies INS direct or intercept steering signals from the INS computer to the pilot's course indicator-selector.
INS DIR (RU-21D)	Applies INS direct steering signal from the INS computer to the copilot's course indicator-selector.

NOTE

In RU-21D aircraft, when the copilot's switch is set to the INS DIR position, the INS computer will compute a straight line course to the desired destination (if it is operating in INS navigation mode) and the lateral steering signals for this course will be applied to the course deviation indicator deflection circuits of the copilot's indicator. When the pilot's switch is set to the INS position, lateral steering signals for an INS direct or intercept course, depending on the position of the copilot's switch, will be applied to the course deviation indicator deflection circuits of the pilot's indicator. Glideslope steering signals will be applied to the horizontal pointer deflection circuits of both indicators whenever the marker beacon-glideslope receiver is operating, except when the respective COURSE IND switch is in the HOME position.

INS INTCP	Applies INS direct steering signal from the INS computer to the copilot's course indicator-selector.

NOTE

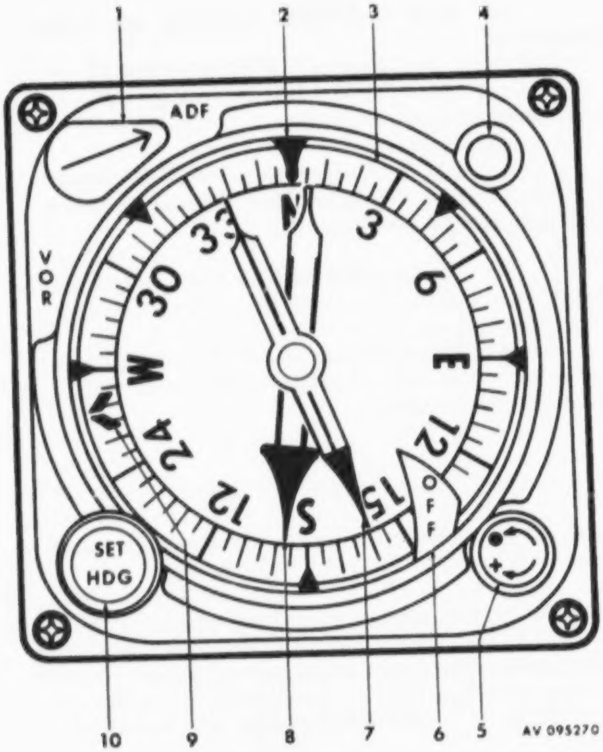
In RU-21D aircraft, when the copilot's switch is set to the INS INTCP position, the INS computer will compute an intercept course to the desired destination (if it is operating in the navigation mode), and the lateral steering signals for this course deviation indicator deflection circuits of the copilot's indicator.

3-18. Radio Magnetic Indicators.

The radio magnetic indicators (RMI) (fig. 3-11 and 3-12) are navigational aids which provide aircraft magnetic or directional gyro heading, mission target heading, TACAN magnetic bearing, and INS, VOR or ADF bearing information. The RMIs are protected by the 2-ampere GYRO COMPASS circuit breaker on the copilot's circuit breaker and fuse panel.

a. Pilot's Radio Magnetic Indicator (ID-998/ASN) Functions (fig. 3-11).

CONTROL	FUNCTION
ADF/VOR switch	Selects and applies ADF or VOR signal to single-needle pointer.
TACAN/INS switch (RU-21A) (fig. 2-33)	Selects and applies TACAN magnetic bearing signal or INS bearing-minus-heading depending on position of TACAN/INS switch.
Compass card	Indicates aircraft compass magnetic or directional gyro heading or INS heading at top of dial.
Annunciator window	Indicates gyro magnetic compass synchronization in slaved mode.
Synchronizing control	Synchronizes compass card with gyro magnetic compass. (para. 3-19).
OFF flag	Indicates equipment failure.
Single-needle pointer	Indicates ADF bearing or VOR magnetic bearing, depending on position of ADF/VOR switch.
Double-needle pointer	Indicates TACAN bearings.



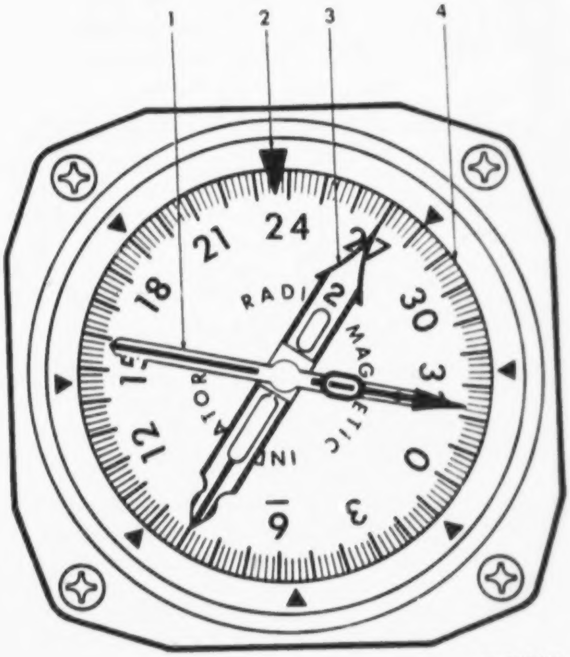
1. ADF/VOR switch
2. Heading index
3. Compass card
4. Annunciator window
5. Synchronizing control
6. OFF flag
7. Single-needle pointer
8. Double-needle pointer
9. Heading cursor
10. SET HDG control

Figure 3-11. Pilot's Radio Magnetic Indicator (ID-998/ASN)

Double-needle pointer (RU-21A)	Indicates TACAN magnetic bearing or INS bearing-minus-heading depending on position of TACAN/INS switch.
Heading cursor	Provides visual indication of heading selected by SET HDG control.
SET HDG control	Sets heading cursor.

b. Copilot's Radio Magnetic Indicator (ID-250/ARN) Functions (fig. 3-12).

CONTROL	FUNCTION
ADF/VOR switch	Selects and applies ADF or VOR signal to the single-needle pointer.
TAC/INS switch (RU-21D)	Selects and applies TACAN magnetic bearing signal or INS bearing-minus-heading signal to the double-needle pointer.
Single-needle pointer	Indicates ADF or VOR magnetic bearing, depending on position of ADF/VOR switch.
Double-needle pointer	Indicates TACAN magnetic bearing or INS bearing-minus-heading depending on position of TAC/INS switch.



1. Single-needle pointer
2. Heading index
3. Double-needle pointer
4. Compass card

Figure 3-12. Copilot's Radio Magnetic Indicator (IC-250/ARN)

Compass card	Indicates aircraft compass magnetic or directional gyro heading, or INS heading, at top of dial.

3-19. Gyro Magnetic Compass Set (AN/ASN-43).

a. Description. The gyro magnetic compass set provides heading information, referenced to a free directional gyro heading when operated in the DG mode (free gyro), or slaved to the earth's magnetic field when operated in the MAG mode (magnetically slaved). It provides heading information in the form of a synchro output to the pilot's RMI (ID-998/ASN) and copilot's RMI (ID-250/ARN) (para. 3-17b.). There are no front panel fuses or circuit breakers provided for the gyro magnetic compass set.

NOTE

Additional controls for the gyro magnetic compass are provided on the pilot's RMI (ID-998/ASN) and on the directional gyro.

b. Compass Slave Switch. The compass slave switch located on the instrument panel, (fig. 2-36 or 2-37) placarded COMPASS SLAVE, is used to control the operating mode of the gyro magnetic compass set.

c. Gyro Magnetic Compass Operation (fig. 2-36 or 2-37).

(1) Alignment operating procedure:

1. COMPASS SLAVE switch (instrument panel) – MAG.

2. Synchronizing control (pilot's RMI ID-998/ASN (fig. 2-36 or 2-37)) – Rotate to align directional gyro with known magnetic heading.

3. Annunciator window (pilot's RMI ID-998/ASN) – Observe for proper slaving signal (alternating plus and ball).

(2) Magnetic heading operating procedure:

1. COMPASS SLAVE switch (instrument panel) – MAG.

2. Compass card on RMIs (pilot's ID-998/ASN, copilot's ID-250/ARN) (fig. 3-11 and 3-12) – Read heading.

(3) Directional gyro heading operating procedure:

1. COMPASS SLAVE switch (instrument panel) – DG.

2. Synchronizing control (pilot's RMI (ID-998/ASN)) – Rotate to align compass card with known magnetic heading.

3. Compass card on RMIs (pilot's ID-998/ASN, copilot's ID-250/ARN) – Read heading.

(4) Shutdown procedure: The set is shutdown with the MAIN INVERTER select switch being turned to OFF.

3-20. Vertical Gyro External Torque/Fast Erect Switch. RU-21D

The fast erection-external torque switch (fig. 2-34) placarded EXT TORQUE/FAST ERECT, perform the following functions:

CONTROL	FUNCTION
EXT TORQUE/ FAST ERECT switch	
EXT TORQUE	Applies a test signal to the vertical gyro control circuits, causing the vertical gyro to precess, and the pilot's attitude indicator to deflect slowly in both roll and pitch.
FAST ERECT	Applies a fast erection signal to the applicable vertical gyro to erect the vertical position at a faster rate than normal

3-21. MD-1/INS Switch. RU-21D

The MD-1/INS switch (fig. 2-37) is used to select the source of the aircraft roll and pitch information which is displayed on the pilot's attitude indicator (fig. 3-13). In the MD-1 position, the roll and pitch inputs will be supplied by the vertical gyro. In the INS position, roll and pitch inputs will be supplied by the gyro-stabilized platform of the INS.

NOTE

Presence of OFF flag on pilot's attitude indicator indicates loss of power to, or low rotational speed of, vertical gyro; or loss of power in INS gyro platform depending on position of MD-1/INS switch.

NOTE

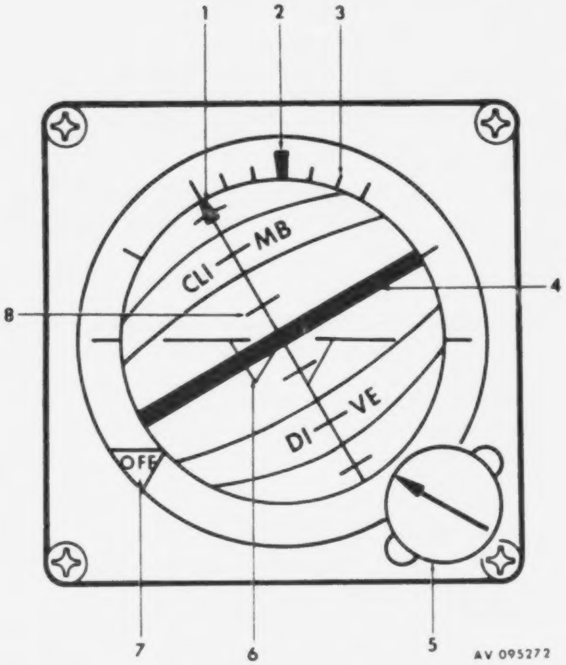
The radar antenna space stabilization signals are always supplied by the vertical gyro.

3-22. Pilot's Attitude Indicators (ARU-13/A).

a. Description. The pilot's attitude indicators (fig. 3-13) are a flight aid which indicates the aircraft attitude. The RU-21A pilot's attitude indicator is protected by the 25-ampere INS circuit breaker in the right subpanel. The RU-21D pilot's attitude indicator is protected by the 5-ampere VERTICAL GYRO fuse in the copilot's circuit breaker and fuse panel.

b. Attitude Indicator Functions (fig. 3-13).

CONTROL	FUNCTION
Bank angle index	Reference indicating zero-degree bank.
Bank angle pointer	Indicates aircraft bank angle.
Bank angle scale	Allows measurement of aircraft bank angle from zero to 90 degrees with marks at 10, 20, 30, 60 and 90 degrees.
Horizon line	Affixed to sphere, remains parallel to the earth's horizon at all times.
Pitch trim control	Aligns the horizon line vertically with the center dot on the miniature aircraft.
Miniature aircraft	Indicates attitude of aircraft with respect to the earth's horizon.
OFF flag	Presence indicates loss of power to, or low rotational speed of vertical gyro.
Sphere	Remains oriented with the earth's horizon at all times.

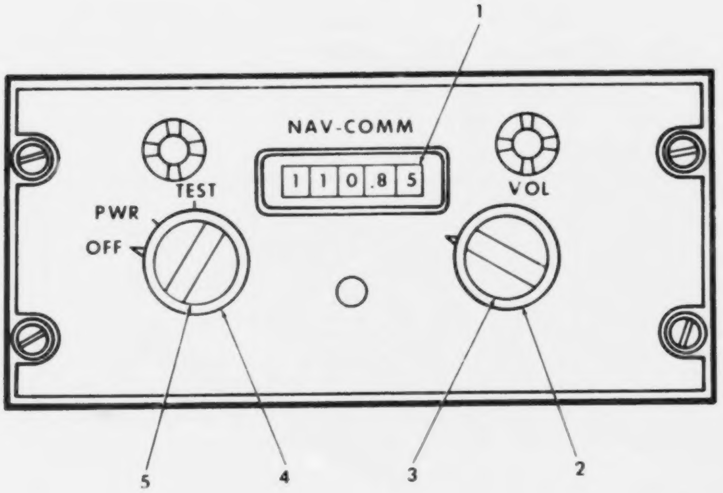


1. Bank angle pointer
2. Bank angle index
3. Bank angle scale
4. Horizon line
5. Pitch trim control
6. Miniature aircraft
7. OFF flag
8. Sphere

Figure 3-13. Attitude Indicator (ARU-13/A)

3-23. VOR Receiver (AN/ARN-82).

This unit is an airborne navigation-communication radio whose function is to receive and interpret VHF omni directional radio range (VOR) and localizer (LOC) signals in the frequency range of 108.00 to 117.95 MHz. Visual indications of the VOR and localizer signals are displayed on the RMIs and the course indicator-selectors. Signal reception is limited to line-of-sight and by the power of the transmitter with a maximum range of 120 miles. Audio signals are fed to the audio control panels. Power for the VOR receiver is fed through the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers on the copilot's circuit breaker and fuse panel. The unit is protected by the 5-ampere VOR circuit breaker on the right subpanel.



1. NAV-COMM frequency indicator
2. VOL control
3. Decimal megahertz selector
4. Power switch
5. Megahertz selector

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Figure 3-14. VOR Control Panel (AN/ARN-82)

a. VOR Control Panel Functions (fig. 3-14).

CONTROL	FUNCTION
Frequency indicator	Indicates the operating frequency.
Frequency selector	Controls operating frequency of the VOR and glideslope receivers. When a localizer frequency is selected, the glideslope receiver is automatically activated and tuned to the correct frequency.
VOL control	Adjusts volume.
Power switch	
OFF	Turns off the VOR receiver and the glideslope portion of the marker beacon-glideslope receiver.
PWR	Turns on the VOR receiver and the glideslope portion of the marker beacon-glideslope receiver.
TEST	Applies self-test signals to the VOR receiver and marker beacon light system.

b. VOR Receiver Operation.

(1) Turn-on procedure: POWER switch – PWR.

(2) VOR receiver operating procedure:

1. Frequency selectors – Select.

2. VOL control – As required.

3. COURSE IND switches (instrument panel, fig. 2-36 or 2-37) – VOR.

4. OBS control (copilot's course indicator-selector, fig. 3-9) – Set to required course.

5. Course deviation indicator (course indicator-selectors, fig. 3-9 and 3-10) read – Read lateral deviation from selected course.

6. To determine course to station on copilot's course indicator-selector:

(1) OBS control – Rotate knob until course deviation pointer is centered and TO-FROM flag reads TO.

(2) Course index – Read course to station.

7. To determine bearing from station on copilot's course indicator-selector:

(1) OBS control – Rotate knob until course deviation pointer is centered and TO-FROM flag reads FROM.

(2) Course index – Read bearing from station.

8. To determine course to station on RMI (pilot's ID-998/ASN, copilot's ID-250/ARN) (fig. 3-11 and 3-12):

(1) ADF/VOR switch (instrument panel or pilot's RMI) – VOR.

(2) Single needle on RMI's – Read course to station.

(3) Localizer (LOC) receiver operating procedure:

1. Frequency selectors – Select.

2. COURSE IND switches (instrument panel, fig. 2-36 or 2-37) – VOR.

3. Course deviation indicator (course indicator-selector) – Steer as required to center needle.

(4) VHF communications operating procedure:

1. Frequency selector – Select.

2. VOL control – As required.

(5) Shutdown procedure: Power switch – OFF.

3-24. Marker Beacon Glideslope Receiver (R-1963/ARN).

The marker beacon-glideslope receiver is used to provide the pilot and copilot with both marker beacon and glideslope information. The glideslope portion provides vertical guidance information to the glideslope deviation indicator on the course indicator-selectors (fig. 3-9 and 3-10) during Instrument Landing System (ILS) approaches. The VOR control panel (fig. 3-14) is used to control application of power and frequency selection of the glideslope circuits within the receiver. The glideslope portion of the receiver operates within a frequency range of 329.15 to 335.00 MHz with a distance range of approximately 20 miles. The marker beacon portion is used to provide the pilot with visual and aural indication of the aircraft's position with respect to a 75 MHz marker beacon transmitter. The visual indication is presented in the form of a flashing light on the pilot's course selector-indicator (fig. 3-9). The light flashes at different intervals, depending on the type of marker beacon signal being received. The aural indication is provided in the form of an audio tone (400, 1300, or 3000 Hz, depending on the type of signal being received). The marker beacon-glideslope receiver is fed through the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers on the copilot's circuit breaker and fuse panel and protected by the 2-ampere GLIDESLOPE MKR circuit breaker on the right subpanel.

a. Marker Beacon-Glideslope Functions (fig. 2-36 or 2-37).

CONTROL	FUNCTION
OFF-VOL control	OFF position turns off the marker beacon-glideslope receiver. Rotation clockwise turns on the marker beacon-glideslope receiver and increases the volume of the marker beacon section.
SENS switch	Controls the sensitivity of the marker beacon section of the marker beacon-glideslope receiver.
MARKER beacon indicator	Illuminates when the aircraft passes over a marker beacon station.

b. Marker Beacon-Glideslope Receiver Operation.

(1) Turn-on procedure: Marker beacon OFF-VOL control (instrument panel, fig. 2-36 or 2-37) – ON, rotate full clockwise.

(2) Marker beacon operating procedure:

1. MARKER beacon indicator (pilot's course indicator selector, fig. 3-9) – Observe for beacon indication.

2. Marker beacon HI-LO SENS switch (instrument panel fig. 2-33 or 2-34) – As required.

(3) Glideslope receiver operating procedure:

1. Frequency selectors (NAV-COMM control panel, fig. 3-14) – Select localizer frequency.

2. COURSE IND switches (instrument panel) – VOR.

3. Glideslope indicator (course indicator-selectors, fig. 3-9 and 3-10) – Read glideslope indications.

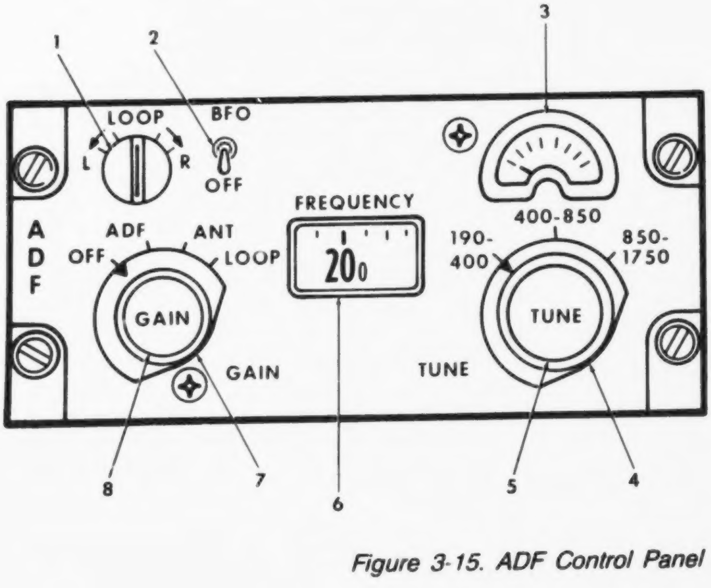
(4) Shutdown procedure: VOR and marker beacon receiver – OFF.

3-25. ADF Radio Set (AN/ARN-83).

The ADF radio set (fig. 3-15) is an airborne low-frequency radio direction finder which receives signals from transmitters in the 190 to 1750 kHz range, to provide a visual and aural indication of the aircraft's bearing in relation to the transmitter. The set can also be used for homing and position fixing. Reception distance of reliable signals depends on the power output of the transmitting station and the atmospheric conditions. The set has a beat frequency oscillator (BFO) function used to more accurately tune weak signals. Bearing indications are displayed visually on the RMIs and aural signals are applied to the audio control panels. Power for the ADF radio set is fed through the 50-ampere AVIONICS NO. 1 and AVIONICS NO. 2 circuit breakers on the copilot's circuit breaker and fuse panel. The unit is protected by the 5-ampere ADF circuit breaker on the right subpanel.

a. ADF Control Panel Functions (fig. 3-15).

CONTROL	FUNCTION
LOOP control	Operative only when the function switch is in the LOOP position. Center position removes rotation signals from the loop antenna and the ADF pointer on the RMIs. First position L (left) or R (right) of center applies slow-speed rotation signals to loop antenna and ADF pointer on RMIs for 360 degree rotation left or right. Second position L (left) or R (right) of center applies fast-speed rotation signals to loop antenna and ADF pointer on RMIs for 90 degree rotation left or right.
BFO-OFF switch	Turns BFO on or off.
Tuning meter	Indicates relative strength of received signal.
Range switch	Selects operating frequency range.
TUNE control	Tunes receiver.
FREQUENCY indicator	Indicates the operating frequency.
Mode selector	Determines operating mode:
OFF	Turns set off.
ADF	Allows homing or automatic direction finding operation.



1. LOOP control
2. BFO switch
3. Tuning meter
4. Range switch
5. TUNE control
6. FREQUENCY indicator
7. Function switch
8. GAIN control

Figure 3-15. ADF Control Panel (AN/ARN-83)

ANT	Allows reception using sense antenna.
LOOP	Allows aural-null homing and manual direction finding operations.
GAIN control	Adjusts volume.

b. ADF Radio Set Operation.

(1) To operate set as automatic direction finder:

1. Mode selector – ADF.

2. BFO-OFF switch – OFF.

3. Range switch – Select.

4. TUNE control – Rotate for maximum reading on tuning meter.

5. GAIN control – As required.

6. ADF/VOR switch (instrument panel or pilot's RMI) – ADF.

7. ADF/UHF-DF switch (RU-21A) (instrument panel) – ADF.

8. Single-needle on RMI (pilot's, copilot's, fig. 3-11 and 3-12) – Read course to station.

(2) To operate set for sense antenna direction finding:

1. Mode selector – ANT.

2. Range switch – Select.

3. TUNE control – Rotate for maximum reading on tuning meter.

4. GAIN control – As required.

(3) To operate set for aural-null direction finding:

1. Mode selector – ANT.

2. BFO-OFF switch – BFO.

3. Range switch – Select.

4. TUNE control – Rotate for maximum reading on tuning meter.

5. GAIN control – Adjust for low audio output.

6. ADF/VOR switch (instrument panel or pilot's RMI (ID-998/ASN)) – ADF.

7. ADF/UHF-DF switch (RU-21A) (instrument panel) – ADF.

8. BFO-OFF switch – OFF.

9. Mode selector – LOOP.

10. LOOP switch – L or R. Turn left or right until a null is reached (minimum sound in headsets).

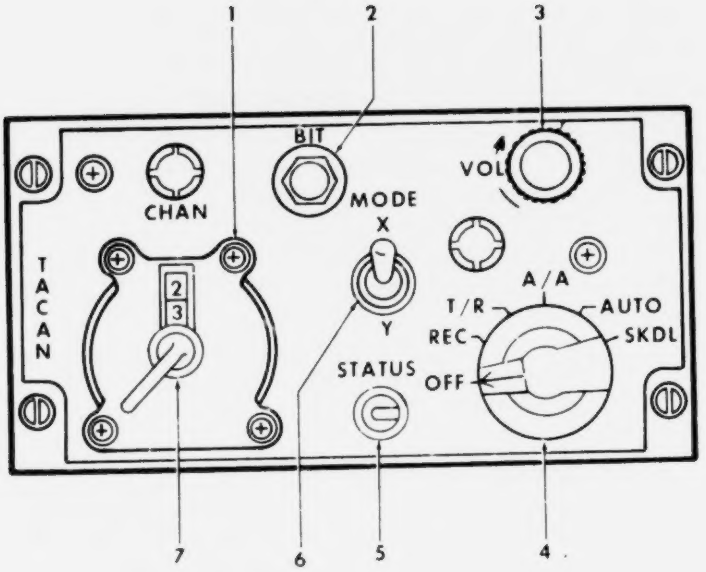
11. Single-needle on RMIs (pilot's ID-998/ASN, copilot's ID-250/ARN) – Read course to station.

NOTE

The true null and direction to the radio station may be indicated by either end of the single-needle. This ambiguity must be solved to determine proper direction to the station.

3-26. TACAN Radio Sets.

a. Description. TACAN Radio Set (AN/ARN-102). RU-21A The TACAN radio set is an airborne navigational set. During tactical deployment, the navigational set is operated in conjunction with other items of surface and airborne electronic equipment including a surface TACAN beacon transponder, a course indicator-selector to display selected course deviation, an RMI to display bearing information, a TACAN distance indicator (fig. 3-18) to display distance to station information, an Inertial Navigation System (INS) for the purpose of automatic correction of inertial navigation positional errors. Application of power channel selection, mode selection, function selection and system self-test is provided by the TACAN control panel (fig. 3-16). The TACAN radio set operates on any one of 126 channels in either the X or Y mode, with maximum range of approximately 290 miles (air to ground slant range). An audio tone of 1350 Hz is provided to the aircraft audio system to identify TACAN beacon signals. Primary power of 115 VAC to operate the TACAN is obtained from the aircraft inverters. Control power of 28 VDC is fed through the AVIONICS No. 1 and AVIONICS No. 2 circuit breakers on the copilot's circuit breaker panel. The



1. CHAN indicator
2. BIT pushbutton
3. VOL control
4. Mode selector
5. STATUS indicator
6. MODE switch
7. CHAN selector

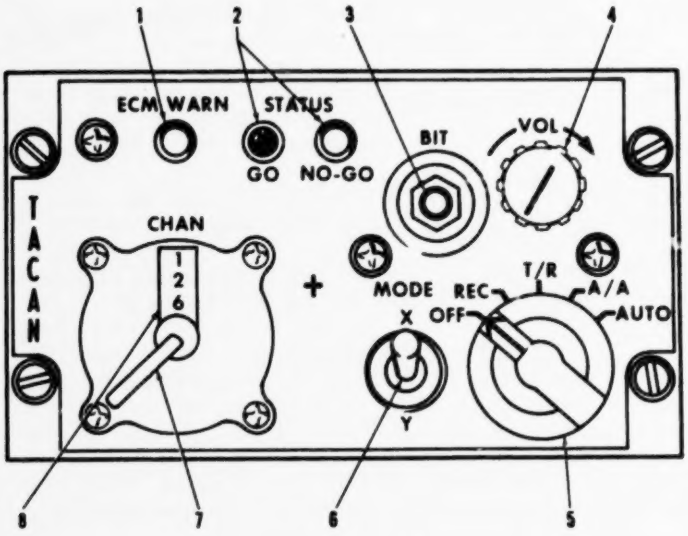
Figure 3-16. TACAN Control Panel (AN/ARN-102)

unit is protected by the 5- ampere TACAN circuit breaker on the right subpanel.

b. Description. TACAN Radio Set (AN/ARN-103). RU-21D The TACAN radio set is an airborne navigational set that operates in conjunction with selected TACAN ground stations or other TACAN equipped aircraft to provide bearing and distance to selected destination. The TACAN radio set operates on one of 252 preselected frequencies: 962 to 1024 MHz (channels 1X through 63X), 1151 to 1213 MHz (channels 64X through 126X), 1088 to 1150 MHz (channels 1Y through 63Y), or 1025 to 1057 MHz (channels 64Y through 126Y). Visual indications of bearing to destination are displayed on the course indicator-selector (fig. 3-9 or 3-10). Distance to destination information is displayed on the TACAN distance indicator (fig. 3-18). Application of power, channel and mode selection is provided by the TACAN control panel (fig. 3-17). The TACAN radio set has a distance range of approximately 300 miles. An audio tone is also applied through the audio control panel to indicate TACAN signal reception. Power for the TACAN radio set is fed through the 50-ampere LH MAIN AVIONICS and RH MAIN AVIONICS circuit breakers on the copilot's circuit breaker panel. The unit is protected by the 5-ampere TACAN circuit breaker on the right subpanel.

c. TACAN Control Panel Functions (AN/ARC-102) RU-21A (fig. 3-16).

CONTROL	FUNCTION
CHAN indicator	Indicates the operating channel.
BIT pushbutton	Initiates a "built-in" self-test sequence.
VOL control	Adjusts volume of signal identification function.
Mode Selector	Determines operating mode:
OFF	Turns TACAN set OFF.
REC	Selects receive portion of receiver transmitter to provide bearing and course information.
T/R	Selects transmit and receive functions for bearing, course and slant range information.
A/A	Selects an air to air transmit and receive function for range tracking with co-operating aircraft.



1. ECM WARN indicator
2. STATUS indicator
3. BIT pushbutton
4. VOL control
5. MODE selector
6. MODE switch
7. CHAN selector
8. CHAN indicator

Figure 3-17. TACAN Control Panel (AN/ARN-103)

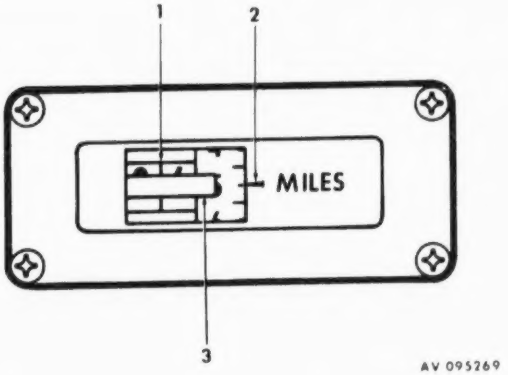
AUTO	Selects receive and transmit functions and enables channel selection to be controlled by the INS computer and is used to automatically evaluate and update the present aircraft position. When in this function the TACAN system is completely controlled by the INS.
SKDL	Not used in this system.
STATUS indicator	Indicates a momentary "GO" indication when "BIT" is initiated and when successfully completed.
MODE switch	Selects either the X or Y operating mode. This selection must be compatible with the surface beacon operating mode.
CHAN	Provides selection of one of 126 present TACAN channels for receiving or transmitting.

d. TACAN Control Panel Functions (AN/ARN-103) RU-21D (fig. 3-17).

CONTROL	FUNCTION
ECM WARN indicator	Indicates when enemy counter-measure signal is trying to jam the TACAN system. May also illuminate when in the immediate vicinity of RF radiation devices, i.e., GCA radar.
STATUS indicator	Indicates a system GO or NO-GO (fault) during self test.
BIT push-button	Initiates a self test sequence and result is displayed by STATUS GO/NO-GO indicators. Also illuminates the ECM WARN and STATUS GO/NO-GO indicators as long as the pushbutton is pressed thereby providing a lamp test feature.
VOL control	Adjusts volume.
Mode selector	Determines operating mode:
OFF	Turns set off.
REC	Selects receive portion of receiver-transmitter for course and bearing information.
T/R	Selects transmit and receive function of receiver-transmitter

	for course and distance information.
A/A	Selects air-to-air transmit and receive function for range information to a cooperating aircraft.
AUTO	INS computer selects the operating mode and channel.
MODE switch	Selects X or Y beacon channels.
CHAN selector	Provides selection of one of 126 TACAN channels in either X or Y mode for receiving and transmitting.
CHAN indicator	Indicates the operating channel.

e. TACAN Distance Indicator Functions (fig. 3-18).



1. MILES indicators
2. Fixed index
3. Power off flag

Figure 3-18. TACAN Distance Indicator (type 339D-1)

CONTROL	FUNCTION
MILES indicator	Indicates slant range in nautical miles for TACAN or horizontal range in nautical miles for INS. Left dial indicates range in one-hundred mile increments. Center dial indicates range in ten-mile increments. Right dial indicates range from zero to 9 miles in one-mile increments.
Fixed index	Provides reference for reading right range dial.
Power off flag	Presence indicates loss of power to the distance indicator.

f. TACAN/INS Switch. The TACAN/INS switch (fig. 2-36 or 2-37) is used to select distance information which is displayed on the TACAN distance indicator (fig. 3-18). In the TACAN position, slant range distance in nautical miles will be displayed. In the INS position, horizontal distance in nautical miles to destination selected on INS control-indicator is displayed.

g. TACAN Norm/Auto Switch RU-21D. The TACAN NORM/AUTO switch (fig. 2-37) is used to engage or disable the TACAN distance indicator and the double-needle pointer of the RMIs. In the TACAN NORM position, distance-in-nautical miles can be read on the TACAN distance indicator, and TACAN magnetic bearing can be read on the double-needle pointer of the RMIs. In the AUTO position, the TACAN distance indicator and double-needle pointer of the RMIs are disabled. The switch must be placed in the AUTO position when the INS is in the update mode. This action prevents excessive movements of the TACAN distance indicator and the double-needle pointer of the RMIs.

h. TACAN DME Disable Switch RU-21A. The TACAN DME disable switch (fig. 2-36) is used to disable the TACAN distance indicator.

i. TACAN Navigation Set Operation (AN/ARN-102) RU-21A.

(1) Turn-on procedure.

1. Function switch – REC.
2. VOL control – As required.

(2) Procedure for self-test.

1. Function switch – T/R.
2. BIT pushbutton – Press.
3. GO will momentarily appear indicating start of test.

4. RMI pointer will move to 360° position.

5. TACAN distance indicator will move to 000 miles range position and power-off flag will go "out of view".

6. After approximately 20 seconds a momentary "GO" indication will reappear indicating successful completion of test.

(3) To determine bearing to a selected ground station:

1. CHAN selector – As required.

2. Function switch – REC.

3. MODE switch – As required.

4. TACAN/INS switch – TACAN.

5. Double-needle on RMI – Read station bearing.

(4) To determine bearing and course deviation to a selected ground station:

1. CHAN selector – As required.

2. Function switch – REC.

3. MODE switch – X.

4. TACAN/INS switch – TACAN.

5. COURSE IND switches – TAC.

6. Double-needle on RMI – Read station bearing.

7. SET control (pilot's course indicator-selector) – As required.

8. Course deviation indicators (pilot's and copilot's indicator-selectors) – Read deviation from selected course. Pointer will show the drift angle when course deviation indicator is centered.

(5) To determine range to a selected ground station:

1. CHAN selector – As required.

2. Function switch – T/R.

3. MODE switch – As required.

4. MILES indicator – Read range.

(6) To determine course a TACAN station:

1. TACAN controls – Set up (as per (4)).

2. SET control (pilot's course indicator-selector) – Rotate until course deviation indicator is centered and TO - FROM flag reads TO.

3. COURSE indicator (pilot's and copilot's course indicator-selectors) – Read course to station.

(7) To determine course FROM a TACAN station:

1. TACAN controls – Set up (as per (4)).

2. SET control (pilot's course indicator-selector) – Rotate until course deviation indicator is centered and TO-FROM flag reads FROM.

3. COURSE indicator (pilot's and copilot's course indicator-selectors) – Read course from station.

NOTE

Functions as outlined in (3), (4), (6) and (7) may also be accomplished with function switch in T/R position.

j. TACAN Navigation Set Operation (AN/ARN-103).

(1) Turn-on procedure.

1. Mode selector – REC.

2. VOL control – As required.

3. BIT pushbutton (ARN-103) – Press and release. GO indicator should illuminate after 10 seconds. If NO-GO indicator illuminates, have system checked by maintenance personnel.

(2) To determine course only to a selected ground station:

1. CHAN selector – As required.

2. Mode selector – REC.

3. TACAN/INS switch (RU-21A) (instrument panel, fig. 2-36) – TACAN, if TACAN course is to be read on pilot's RMI.

4. TAC/INS switch (RU-21D) (instrument panel, fig. 2-37) – TAC, if TACAN course is to be read on copilot's RMI.

5. Double-needle on RMIs (fig. 3-11 and 3-12) – Read course.

(3) To determine course and range to a selected ground station:

1. CHAN selector – As required.

2. Mode selector – T/R.

3. Mode switch – X or Y as required.

4. TACAN/INS switch (RU-21A) (instrument panel) – TACAN.

5. TAC/INS switch (RU-21D) (instrument panel) – TAC.

6. Double-needle on RMIs (instrument panel) – Read course.

7. MILES indicators (TACAN distance indicator) – Read range.

(4) To determine course:

1. TACAN controls – Set up ((2) or (3) above).

2. COURSE IND switches (instrument panel) – TAC.

3. SET control (pilot's course indicator-selector, fig. 3-9) – As required.

4. Course deviation indicator (pilot's and copilot's course indicator-selector, fig. 3-9 and 3-10) – Steer towards needle.

5. Heading pointer (pilot's course indicator-selector) – Read deviation from selected course. This pointer will show the drift angle, if any, when the course deviation indicator is centered.

6. To determine course to the TACAN station:

(a) SET control (pilot's course indicator-selector) – Rotate until course deviation indicator is centered and TO-FROM flag reads TO.

(b) COURSE indicator (pilot's and copilot's course indicator-selector) – Read course to station.

7. To determine bearing from TACAN station:

(a) SET control (pilot's course indicator-selector) – Rotate until course deviation indicator is centered and TO-FROM flag reads FROM.

(b) COURSE indicator (pilot's and copilot's course indicator-selector) – Read bearing from station.

(5) To operate for air-to-air range tracking:

1. Mode selector – A/A.

2. CHAN selector – Set 63 channels difference from master aircraft.

3. MILES indicator – Read range to aircraft being tracked.

(6) Shutdown procedure. Function switch – OFF.

3-27. Pilot's Remote I/P Switch RU-21D

The remote I/P switch (fig. 2-24), located on the pilot's control wheel, is used for tripping the teleprinter in the aural mode of DF operation.

3-28. Pilot's Null Meter RU-21D

The pilot's null meter (fig. 2-37) is used to indicate a visual null (minimum signal) when performing mission VHF direction finding procedures.

3-29. Inertial Navigation System (INS) (AN/ASN-86).

The INS system is a self-contained navigation and attitude-reference system that is totally independent of aircraft maneuvers, conditions, and terrain. The INS, in conjunction with aircraft equipment interface, permits all-weather operations under Instrument Meteorological

Conditions (IMC). The INS provides a visual display of present position data in Universal Transverse Mercator (UTM) coordinates or conventional latitude-longitude coordinates during all phases of the flight. When a selected position is approached or overflown, the INS will display and/or freeze the geographic coordinates of the aircraft's position and provide approach and DEST warning light indications to the pilot. The RU-21A and RU-21D INS system is fed through two 50-ampere circuit breakers placarded INS PWR DIST LH and RH. The INS is also protected by circuit breakers on the INS interface box (fig. 3-19 and 3-20). The INS control-indicator (fig. 3-21) provides controls for power application; mode selection; data memory insertion and display; destination selection, insertion, and display; position update; and display clearings. Indicators are provided for navigation mode status, destination approach and arrival malfunctions, data displays, and directional displays. A light, placarded INS OUT (fig. 2-36) on the RU-21A instrument panel, will remain illuminated when the MODE switch is in the OFF position or anytime a malfunction occurs while in the NAV position. For the same purposes, RU-21D aircraft have a light placarded INS MALFUNCTION (fig. 2-37) on the annunciator panel.

a. *INS Control-Indicator Functions (fig. 3-18).*

CONTROL	FUNCTION
MAL indicator	Illuminates when any component in the navigation set malfunctions.
RDY indicator	Illuminates by flashing when INS is ready for NAV mode.
MEM indicator	Illuminates when heading memory alignment is in progress, or when the heading memory mode is initiated.
DEST indicator	Illuminates when aircraft is within two minutes of destination. Flashes when distance to destination is increasing.
TAC indicator	Illuminates when the INS is using TACAN data for automatic updating of present position.
INS indicator	Illuminates when INS is operating in the navigation mode.
AD indicator	Illuminates when GSPU of the INS malfunctions or when MODE selector is set to AD. Flashes when X10 mode has been

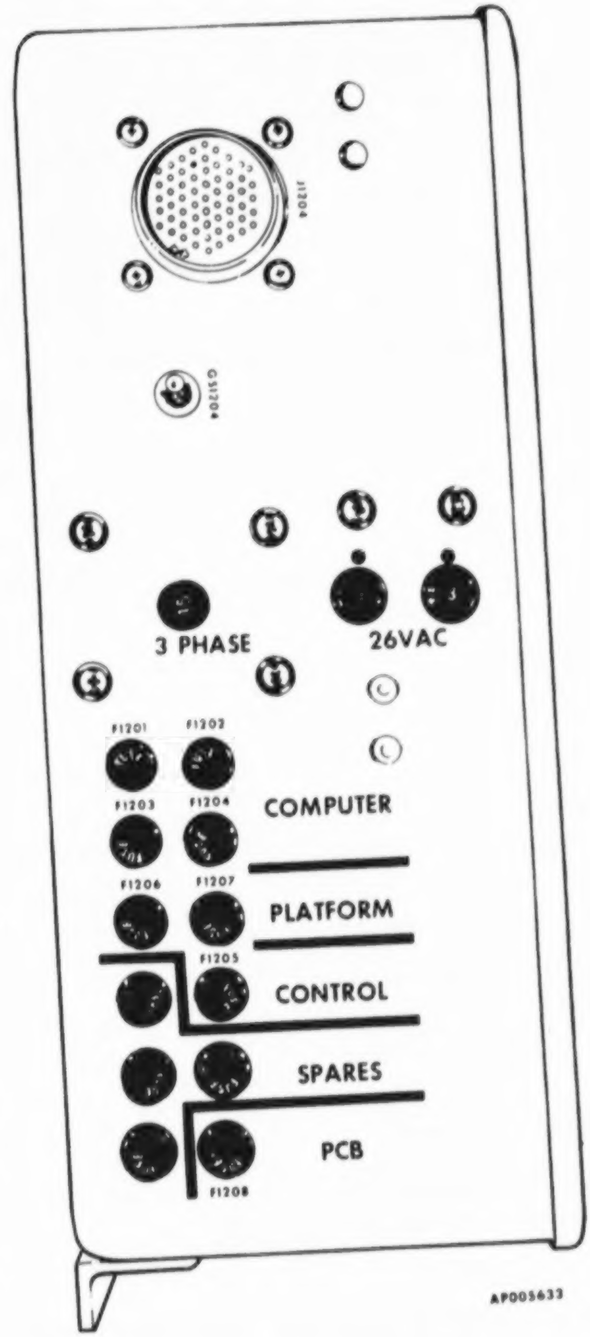
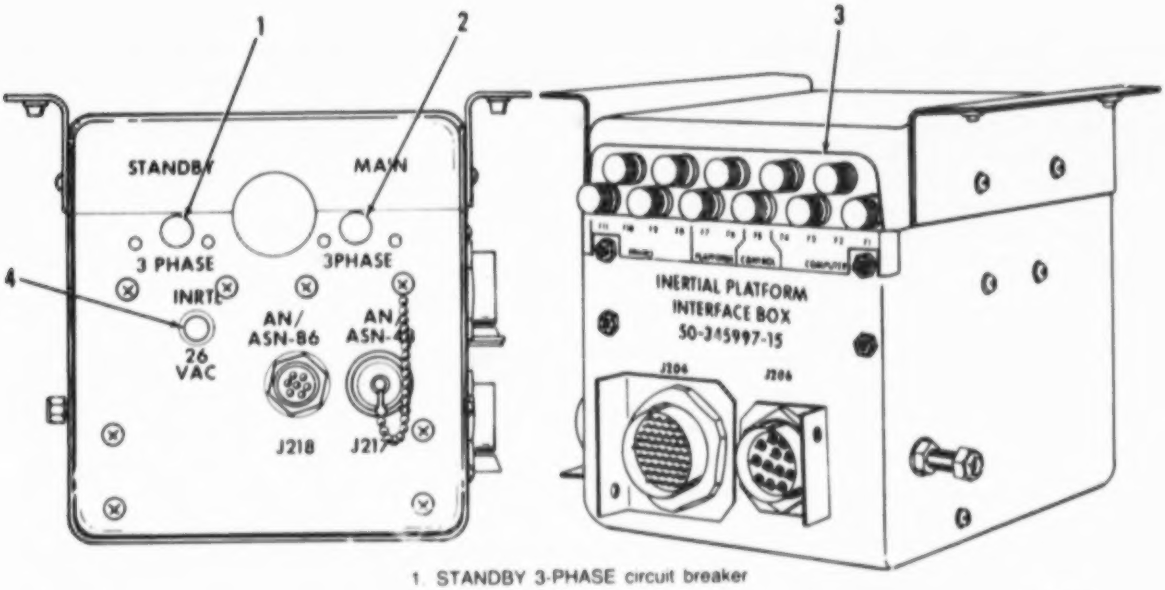


Figure 3-19. INS Interface Box RU-21A



1. STANDBY 3-PHASE circuit breaker
2. MAIN 3-PHASE circuit breaker
3. INS fuse panel
4. INRTL 26 VAC circuit breaker

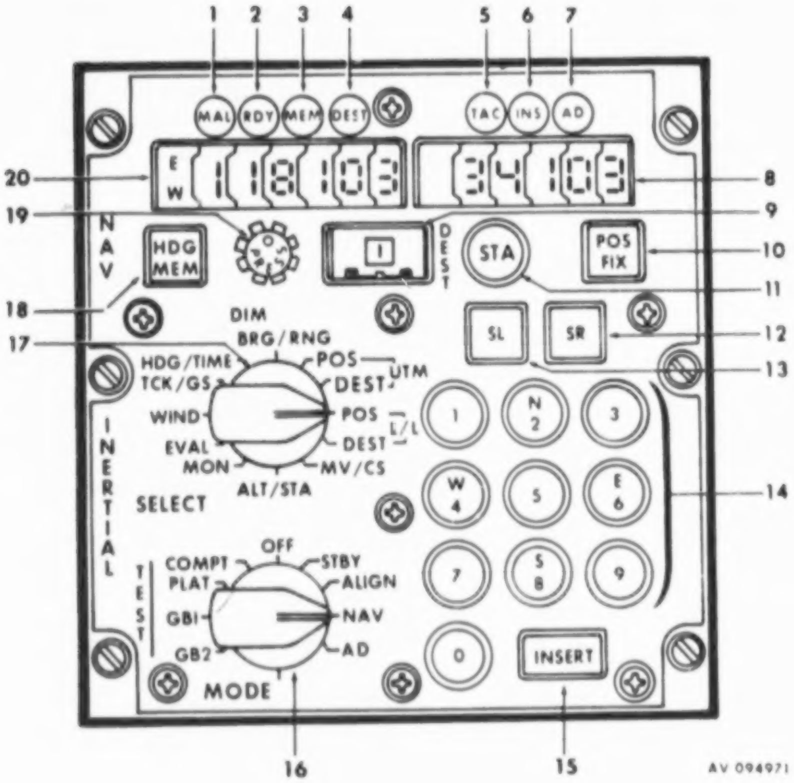
AV 095273

Figure 3-20. INS Interface Box RU-21D

	selected for insertion or display of POS, DEST and EVAL data.
NS (right) display	Indicates direction, north or south, of data displayed on INS control-indicator.
DEST thumbwheel	Allows insertion or display of any core storage location as defined by the position of select switch. With SELECT switch set to MON, decimal quantities are displayed on the right and left displays as follows:

	Left display	Right display
0	Number indicate test failure.	Code number of destination being flown.
1	Y-gyro bias	Z-gyro bias
2	X-gyro bias	Z-gyro bias
3	East velocity error	North velocity error
4	All 1's indicate completion of self-test.	Align status
5	Unused	Time in selected mode.
6	Unused	Spheroid select
7	Unused	Unused
8	Unused	Allows selection of any core storage locations.
9	Displays octal value of contents in selected core storage location.	Displays octal value of contents in selected core storage location.

POS FIX pushbutton	With SELECT switch set to EVAL, UTM POS, or L/L POS, left and right displays will be frozen when POS FIX pushbutton is pressed. Used for position update. If no manual update, "unfreezes" display when pressed for a second time.
STA pushbutton	Used in conjunction with DEST thumbwheel to select destination or TACAN stations. There are 20



1. MAL indicator
2. RDY indicator
3. MEM indicator
4. DEST indicator
5. TAC indicator
6. INS indicator
7. AD indicator
8. Right display
9. DEST thumbwheel
10. POS FIX pushbutton
11. STA pushbutton
12. SR pushbutton
13. SL pushbutton
14. Keyboard pushbutton
15. INSERT pushbutton
16. MODE switch
17. SELECT switch
18. HDG MEM pushbutton
19. DIM-PRESS pushbutton
20. Left display

Figure 3-21. INS Control-Indicator (AN/ASN-86)

	locations allocated for storage of destination or TACAN data. With STA pushbutton OUT (dim) the selected DEST thumbwheel number pertains to the ten locations (0 through 9) set for destination data. With STA indicator IN (bright) the selected DEST thumbwheel number pertains to the ten locations (10 thru 19) set up for TACAN data. These locations can also be used for additional destination data.
SR push-button	When pressed, clears right display and causes INSERT indicator to brighten. When pressed a second time will bring back display and dim the insert light.
SL push-button	When pressed, clears left display and causes INSERT indicator to brighten. When pressed a second time will bring back display and dim the insert light.
Keyboard Pushbuttons	Keys are pressed in conjunction with SELECT switch, DEST thumbwheel, SL, SR, STA and INSERT pushbutton to load left and right displays.
INSERT pushbutton	Used in conjunction with SELECT switch, DEST thumbwheel, SL, SR, and keyboard, to load left and right displays for display and storage in computer.
MODE selector	Selects mode of operation as follows:
OFF	Turns set off.

STBY	Applies primary power to computer and control-indicator, and heater power to platform.
ALIGN	Allows platform stable element to be leveled with respect to local vertical and aligned to true north.
NAV	Normal mode for flight or when aircraft is moved on ground when navigation set is on.
AD	Initiates air data mode of operation which is used when platform malfunctions during flight. INS will automatically switch to AD if the platform fails.
TEST-COMPT	Initiates built-in test of computer.
TEST-PLAT	Initiates built-in test of platform.
TEST GB 1	Initiates gyro bias 1 test.
TEST-GB 2	Initiates gyro bias 2 test.
SELECT	Selects data to be read into memory or displayed, control-indicator displays as follows:
BRG/RNG	Displays bearing-to-destination in degrees and tenths of a degree on left display and range-to-destination in kilometers and tenths of a kilometer on right display for destination or TACAN selected by STA pushbutton and DEST thumbwheel. RMI, range indicator and course indicator-selector will indicate course deviation bearing and range to destination by selecting desired destination or TACAN with STA pushbutton and DEST thumbwheel and pressing the INSERT pushbutton. The insert light will go out; but illuminate for all other positions of the DEST thumbwheel.
UTM POS	Allows insertion or display of present position zone number and easting distance in kilometers and tenths of a kilometer on left display and northing or southing distance in kilometers and tenths of a kilometer on right display Information is automatically inserted into DEST "O" during ALIGN mode.
UTM DEST	Allows insertion or display of destination zone number and easting distance in kilometers and tenths of kilometer on left display and northing or southing distance in kilometers and tenths of a kilometer on right display for destination or TACAN selected by STA pushbutton and DEST thumbwheel.
L/L POS	Allows insertion or display of present position longitude in degrees and minutes on left display and latitude in degrees and minutes on right display. Information is automatically inserted into DEST "O" during ALIGN mode.
L/L DEST	Allows insertion or display of destination position longitude in degrees and minutes on left display and latitude in degrees and minutes on right display for destination or TACAN selected by STA pushbutton and DEST thumbwheel.
EVAL	Allows updating and display of difference between present position and destination number selected with STA pushbutton and DEST thumbwheel. The north-south difference in kilometers and tenths appears on the right display; the east-west difference in kilometers and tenths appears on the left display.
MON	Allows display and selection of any computer core storage location.
EW (left)	Indicates direction, east or west, of data display on INS control-indicator.

ALT/STA	Allows insertion or readout of insertion of required aircraft altitude above sea level on left display when STA pushbutton is out (or indicator is dim). Allows insertion or readout (left display) of altitude above sea level of the TACAN station and insertion or readout (right display) of the selected TACAN station channel number as selected by the DEST thumbwheel with STA pushbutton IN (or indicator is bright).
WIND	Allows display of wind direction angle in degrees and tenths of a degree relative to true north on left display and wind speed in knots and tenths of a knot on right display during navigate mode. During air data mode allows insertion of wind speed and direction.
MV/CS	Allows insertion or display of magnetic variation angle in degrees and tenths of a degree on left display and course select angle in degrees and tenths of a degree on right display relative to true north.
TCK/GS	Allows display of ground track angle in degrees and tenths of a degree on relative to true north on left display and ground speed in knots and tenths of a knot on right display.
HDG/ TIME	Allows display of aircraft heading angle in degrees and tenths of a degree to true north on left display and time-to-destination in minutes and tenths of a minute on right as defined by destination number selected on DEST thumbwheel and position of STA pushbutton.
HDG MEM pushbutton	Used to retain platform alignment after landing. Permits another flight to be made without performing another complete platform alignment.
DIM pushbutton	When rotated it adjusts light intensities, when pressed, illuminates the E, W, N, S, and degree, colon, and decimal points, and all other lights except the data entry indicators and SL and SR indicators. The display readout will show all 8's. It will also place the INS in X10 mode, for insertion or display of UTM, L/L and EVAL data. Press again to cancel X10 mode.

b. INS Operation.

NOTE

The following data will be required prior to operating the INS: Local magnetic variation, latitude and longitude or Universal Transverse Mercator (UTM) coordinates of the aircraft during INS alignment. This information is necessary to program the INS computer during alignment procedure.

NOTE

When inserting data into the INS computer, always start at the left and work to the right. The first digit inserted will appear in the right position of the applicable display. It will step to the left as each subsequent digit is entered. The degree sign, decimal point, and colon (if applicable) will appear automatically.

(1) Turn-on procedure:

NOTE

The aircraft must be connected to a ground power unit if INS alignment is performed prior to engine starting. In this event the engines must not be started until after the INS is placed in the NAV mode.

1. MODE selector – STBY.

2. DIM pushbutton – Press. Assure that MAL, RDY, MEM, DEST, TAC, INS, AD, STA, POS FIX and INSERT indicators are on. Assure that all 8's appear in left and right displays. Assure that E, W, N, S, degree, colon, and decimal point lights come on.

3. DIM pushbutton – Rotate to adjust light intensity.

NOTE

If MEM indicator remains on when the DIM pushbutton is released, the INS had been placed in the heading memory before last shutdown. If the aircraft has not been moved since the last shutdown then a heading memory alignment can be performed by proceeding to step 8.

NOTE

Mistakes in the data being inserted into the computer can be corrected in the following manner: (1) If the mistake is detected prior to pressing the INSERT pushbutton, press the SL or SR pushbutton, as applicable, twice, and repeat the data entry procedure. (2) If the mistake is detected after INSERT pushbutton has been pressed, press the SL or SR pushbutton, as applicable, and repeat the data entry procedure.

NOTE

If longitude and latitude coordinates are being used, skip step 4 and proceed with step 5.

NOTE

To insert UTM data to 10 meter accuracy or L/L data to one-hundredth of a minute accuracy, refer to X10 Mode Procedure.

4. To insert UTM coordinates of aircraft position:

(1) SELECT switch – UTM POS.

(2) DEST thumbwheel – "0".

(3) STA pushbutton – Press (if STA indicator is on). Note that STA indicator dims.

(4) SL pushbutton – Press. Note that INSERT indicator brightens.

(5) Data entry pushbutton E/6 – Press. E (for easting) will appear in left display.

(6) Applicable data entry pushbutton – Press. Insert easting zone number and distance in kilometers and tenths of kilometers. Data will appear on left display.

(7) INSERT pushbutton – Press. Note that INSERT indicator dims and information on left display is correct.

(8) SR pushbutton – Press. Note that right displays clears and INSERT indicator brightens.

(9) Data entry pushbutton N/2 or S/8 – Press applicable pushbutton, N for northing, or S for southing, will appear in right display.

(10) Applicable data entry pushbutton – Press. Insert northing or southing distance in kilometers and tenths of kilometers. Data will appear in right display.

(11) INSERT pushbutton – Press. Note that INSERT indicator dims and information on right display is correct. Proceed to step (10).

5. To insert latitude-longitude coordinates of aircraft position:

(1) SELECT switch – L/L POS.

(2) DEST thumbwheel – "0".

(3) STA pushbutton – Press (if STA indicator is on). Note that STA indicator dims.

(4) SL pushbutton – Press. Note that left display clears and INSERT indicator brightens.

(5) Data entry pushbutton E/6 or W/4 – Press applicable pushbutton. E for east, or W for west, longitude will appear in left display.

(6) Applicable data entry pushbutton – Press. Insert longitude in degrees, minutes, and tenths of minutes. Data will appear in left display.

(7) INSERT pushbutton – Press. Note that INSERT indicator dims and information on left display is correct.

(8) SR pushbutton – Press. Note that right display clears and INSERT indicator brightens.

(9) Data entry pushbutton N/2 or S/8 – Press. N or S for the hemisphere will appear in the right display.

(10) Applicable data entry pushbuttons – Press. Insert latitude in degrees, minutes, and tenths of minutes. Data will appear in right display.

(11) INSERT pushbutton – Press. Note that INSERT indicator dims and information on the right display is correct.

6. To insert local magnetic variation:

(1) SELECT switch – MV/CS.

(2) SL pushbutton – Press. Note that left display clears and INSERT indicator brightens.

(3) Data entry pushbutton E/6 or W/4 – Press applicable pushbutton. E or W for direction of variation will appear in left display.

(4) Applicable data entry pushbuttons – Press. Insert local magnetic variation in degrees and tenths of a degree. Data will appear in left display.

(5) Insert pushbutton – Press. Note that INSERT indicator dims and information on left display is correct.

7. To insert aircraft altitude.

(1) Set SELECT switch to ALT/STA.

(2) If STA indicator is bright, press STA pushbutton. Make sure the STA indicator dims.

(3) Press SL pushbutton. Make sure the left display clears and INSERT indicator brightens.

(4) Press applicable data entry pushbutton to insert altitude above sea level in thousands of feet to nearest one hundred feet.

(5) INSERT pushbutton – PRESS. Note INSERT indicator dims and information in the left display is correct.

NOTE

Before operating in NAV mode it is necessary that the present aircraft altitude (or field elevation) is inserted in the INS. This is to minimize erroneous TACAN slant range calculations by the INS while on the ground.

8. MODE selector – ALIGN.

NOTE

Do not move the aircraft while the MODE selector is in the ALIGN position. Do not start the engines until the mode selector is in the NAV position. During INS alignment other programming can be performed.

9. RDY indicator – Indicator should flash in approximately 12 minutes, 4 minutes if heading memory alignment was performed.

NOTE

Before operating in NAV mode it is necessary that the present aircraft altitude (or field elevation) is inserted in the INS.

10. MODE selector – NAV.

NOTE

Align the pilot's RMI (ID-998/ASN) compass card with the known magnetic heading.

NOTE

The NAV position of the MODE selector is detented. To switch from the NAV position, pull up and turn the MODE selector. If the MAL indicator comes on when the MODE selector is set to NAV, set the SELECT switch to MON and thumbwheel DEST ZERO. The numerals 1 or 3 will appear in the left display to indicate a computer malfunction. Appearance of numeral 4 or 5 will indicate a platform malfunction.

11. INS indicator – ON. The INS is ready for flight.

NOTE

The following programming steps may be accomplished after takeoff.

(2) To program destinations or TACAN coordinates:

NOTE

If latitude and longitude coordinates are being used, skip step 1 and proceed with step 2. Enter all of the data for a given destination or TACAN before starting to enter the data for another.

1. To insert UTM coordinates:

NOTE

To insert UTM data to 10 meter accuracy and L/L data to one-hundredth of a minute accuracy, see X10 Mode procedure.

(1) SELECT switch – L/L DEST.

(2) DEST thumbwheel – Select number representing the desired destination or TACAN.

(3) STA pushbutton – Select STA indicator IN (bright) program TACAN data select STA indicator OUT (program destination data).

(4) SL pushbutton – Press. Note that left display clears and INSERT indicator brightens.

(5) Data entry pushbutton E/6 – Press. E appears in left display.

(6) Applicable data entry pushbuttons – Press. Insert easting zone number and distance in kilometers and tenths of kilometers. Data will appear in left display.

(7) INSERT pushbutton – Press. Note that INSERT indicator dims and information in left display is correct.

(8) SR pushbutton – Press. Note that right display clears and INSERT indicator brightens.

(9) Data entry pushbutton N/2 or S/8 – Press applicable pushbutton. N for northing or S for southing will appear in right display.

(10) Applicable data entry pushbuttons – Press. Insert distance in kilometers and tenths of a kilometer. Data will appear in right display.

(11) INSERT pushbutton – Press. Note that INSERT indicator dims and information in right display is correct.

(12) DEST thumbwheel – Select next desired destination number. Repeat steps (3) through (11) for up to a total of ten destinations, plus 10 TACAN locations.

2. To insert latitude-longitude coordinates of destinations:

(1) SELECT switch – L/L DEST.

(2) DEST thumbwheel – Select desired destination number.

(3) STA pushbutton – Select STA indicator IN (bright) program TACAN data. Select STA indicator out (program destination data).

(4) SL pushbutton – Press. Note that left display clears and INSERT indicator dims.

(5) Data entry pushbutton E/6 or W/4 – Press applicable button. E or W will appear in left display.

(6) Applicable data entry pushbuttons – Press. Insert longitude in degrees, minutes, and tenths of a minute. Data will appear in left display.

(7) INSERT pushbutton – Press. Note that INSERT indicator dims and information in left display is correct.

(8) SR pushbutton – Press. Note that right display clears and INSERT indicator brightens.

(9) Data entry pushbutton N/2 or S/8 – Press applicable button. N or S will appear in right display.

(10) Applicable data entry pushbuttons – Press. Insert latitude in degrees, minutes, and tenths of a minute. Data will appear in right display.

(11) INSERT pushbutton – PRESS. Note that INSERT indicator dims and information in right display is correct.

(12) DEST thumbwheel – Select next desired destination number. Repeat steps (3) through (11) for up to a total of 10 destinations, plus 10 TACAN locations.

(3) To program true course angles and TACAN station local magnetic variation:

1. SELECT switch – MV/CS.

2. DEST thumbwheel – Select desired number.

3. STA pushbutton – Select STA indicator IN (bright) program TACAN data. Select STA indicator out (program destination data).

4. SR pushbutton – PRESS if a course angle is to be programmed. Note right display clears and INSERT indicator brightens.

(1) Data entry pushbuttons – press to insert desired course angle in degrees and tenths of a degree.

(2) INSERT pushbutton – Press. Note the INSERT indicator dims and the information in the right display is correct.

5. SL pushbutton – Press if TACAN station local magnetic variation is to be programmed. Note left display clears and INSERT indicator brightens.

(1) Data entry pushbutton – Press to insert TACAN station local magnetic variation in degrees and tenths of a degree.

(2) INSERT pushbutton – Press. Note the INSERT indicator dims and the information in the left display is correct.

(4) To program TACAN station tower altitude and channel number:

1. SELECT switch – ALT/STA

2. DEST thumbwheel – Select desired number.

3. STA pushbutton – If STA indicator is dim, press STA pushbutton and make sure STA indicator brightens.

4. SL pushbutton – press if tower altitude is to be programmed. Left display clears and INSERT indicator brightens.

(1) Data entry pushbuttons – Press to insert tower altitude in thousands of feet to the nearest hundred feet.

(2) INSERT pushbutton – Press. Note the INSERT indicator dims and the information in the left display is correct.

5. SR pushbutton – Press if TACAN channel number is to be programmed.

(1) Data entry pushbuttons – Press to insert TACAN channel number.

(2) INSERT pushbutton – Press. Note the INSERT indicator dims and the information in he right display is correct.

(5) Designating fly-to-destinations or TACAN:

1. DEST thumbwheel – Select desired number.

2. STA pushbutton – Select bright or dim as appropriate to represent desired destination or TACAN.

3. SELECT switch – BRG/RNG. Insert indicator should brighten. If not, then the selected destination or TACAN is presently designated.

4. INSERT pushbutton – Press. Note that INSERT indicator dims.

NOTE

Navigation information is now available from the INS for display on the pilot's RMI (ID-998/ASN) and on the pilot's and copilot's course indicator-selector as determined by the course indicator switches (para. 3-17).

(6) To fly the selected INS course:

1. Pilot's COURSE IND switch (instrument panel) – INS.

2. Course deviation indicators (pilot's and/or copilot's course indicator-selectors) – Steer toward indicators.

3. DEST INDICATOR – Indicator will illuminate when the aircraft is within two-minutes flying time of the destination. Indicator flashes when distance to destination begins to increase (station overflown).

4. TACAN/INS switch (instrument panel) – INS (if required).

5. Double-needle pointer (RMI ID-998/ASN) – Pointer will show drift angle when on-course during an INS direct course.

(7) To obtain readouts from the INS:

NOTE

To read out UTM and EVAL data to 10 meter accuracy and L/L data to one-hundredth of a minute accuracy, refer to X10 Mode procedure.

NOTE

Refer to table 3-1 for the values and units of measurements of the display readouts.

1. To read bearing and range to destinations or TACAN:

(1) DEST thumbwheel – Select desired destination number.

(2) STA pushbutton – Select STA indicator in (bright) program TACAN data. Select STA indicator out (program destination data).

(3) SELECT switch – BRG/RNG. INSERT indicator should brighten (if not the selected destination or TACAN is presently designated).

(4) INSERT pushbutton - Press (note insert indicator dims).

(5) Left display – Read bearing to destination.

(6) Right display – Read range to destination.

2. To read present position in UTM coordinates:

(1) SELECT switch – UTM POS.

(2) Left display – Read easting zone number and aircraft easting.

(3) Right display – Read aircraft northing or southing.

3. To read present position in longitude and latitude:

(1) SELECT switch – L/L POS.

(2) Left display – Read aircraft longitude (east or west).

(3) Right display – Read aircraft latitude and hemisphere.

4. To read destination or TACAN UTM coordinates:

(1) DEST thumbwheel – Select desired destination number.

(2) STA pushbutton – Select STA indicator in (bright) program TACAN data. Select STA indicator out (program destination data).

Table 3-1. INS Control-Indicator Display Readout

SELECT SWITCH POSITION	MAXIMUM VALUE OF VARIABLE - LEFT DISPLAY	UNIT OF VARIABLE - LEFT DISPLAY	MAXIMUM VALUE VARIABLE - RIGHT DISPLAY	UNITS OF VARIABLE - RIGHT DISPLAY
BRG/RNG	0359.9	Degrees	9999.9	Kilometers
UTM POS*	E 60:999.9	Kilometers	N/S 9999.9	Kilometers
UTM POS*	E 60:999.9	Kilometers	N/S 9999.9	Kilometers
L/L POS*	E/W 179°59.9	Degrees & Minutes	N/S 89°59.9	Degrees & Minutes
L/L DEST*	E/W 179°59.9	Degrees & Minutes	N/S 89°59.9	Degrees & Minutes
MV/CS	E/W 00179.9	Degrees	359.9	Degrees (true)
ALT/STA	99999.9	Feet (1000's)	00126	No Units
MON	E/W 99999.9	Variable	N/S 9999.9	Variable
EVAL*	E/W 09999.9	Kilometers	N/S 9999.9	Kilometers
WIND	00359.9	Degrees (true)	0600.0	Knots
TCK/GS	00359.9	Degrees (true)	0600.0	Knots
HDG/TIME	00359.9	Degrees (true)	9999.9	Minutes

*When X10 Mode has been selected, all digits will shift one place to the left so that the last digit on the right will represent 10 meters (UTM and EVAL) or one-hundredth of a minute (L/L).

(3) SELECT switch – UTM DEST.

(4) Left display – Read destination easting.

(5) Right display – Read destination northing or southing.

5. To read destination or TACAN longitude and latitude coordinates:

(1) DEST thumbwheel – Select desired destination number.

(2) STA pushbutton – Select STA indicator in (bright) program TACAN data. Select STA indicator out (program destination data).

(3) SELECT switch - BRG/RNG. INSERT indicator should brighten (if not the selected destination or TACAN is presently designated).

(4) INSERT pushbutton - PRESS (note insert indicator dims).

(5) SELECT switch – L/L DEST.

(6) Left display – Read destination longitude.

(7) Right display – Read destination latitude.

6. To read local magnetic variation and course select angle:

(1) DEST thumbwheel – Select desired number.

(2) STA pushbutton – Select STA indicator in (bright) program TACAN data. Select STA indicator out (program destination data).

(3) SELECT switch BRG/RNG. INSERT indicator should brighten (if not the selected destination or TACAN is presently designated).

(4) INSERT pushbutton PRESS (note insert indicator dims).

(5) SELECT switch – MV/CS.

(6) Left display – Read present position, insert magnetic variation or TACAN.

(7) Right display – Read course select angle for destination (referenced to true north).

7. To read wind direction and velocity:

(1) SELECT switch – WIND.

(2) Left display – Read wind direction.

(3) Right display – Read wind velocity.

8. To read track and ground speed:

(1) SELECT switch – TCK/GS.

(2) Left display – Read aircraft ground track angle (referenced to true north).

(3) Right display – Read aircraft ground speed.

9. To read aircraft heading and time to destination or TACAN:

(1) DEST thumbwheel – Select desired number.

(2) STA pushbutton – STA indicator in (bright) program TACAN data. Select STA indicator out (program destination data).

(3) SELECT switch - BRG/RNG. INSERT indicator should brighten (if not the selected destination or TACAN is presently designated).

(4) INSERT pushbutton - PRESS (note insert indicator brightens).

(5) SELECT switch – HDG/TIME.

(6) Left display – Read aircraft heading. Reading is angle relative to true north.

(7) Right display – Read time to destination or TACAN.

(8) Manual INS update:

NOTE

Manual INS update should be used only when TACAN updating is unreliable.

1. Visual landmark INS update.

(1) Fly the aircraft directly over a location of known coordinates and press the POS FIX pushbutton at the exact instant that the aircraft is over the known location. Note that the POS FIX indicator brightens.

NOTE

The POS FIX pushbutton may be pressed with the SELECT switch in any position. In the UTM POS or L/L POS positions, the displays indicate the coordinate information at the instant the POS FIX pushbutton was pressed. In the EVAL position, the difference between known and computer coordinates will be indicated.

(2) DEST thumbwheel – Select destination used as fix position.

(3) STA pushbutton – Press if STA indicator is bright.

(4) SELECT switch – EVAL. Read difference between known coordinates and computed coordinates of selected destination. Note that INSERT pushbutton brightens.

(5) INSERT pushbutton – Press only if visual update is needed. Note that INSERT and POS FIX indicators dim.

(6) POS FIX pushbutton – Press if indicator is bright.

2. Navigation radio INS update.

NOTE

It is essential that the exact coordinates of the VOR, ADF, or TACAN station be programmed into the INS prior to update. Follow the procedures in paragraph B(2) above for updating inserting position update coordinates into the INS.

(1) East-West manual INS update using VOR, ADF, or TACAN stations can be accomplished by flying the aircraft so that it will cross the true 0° or 180° bearing to the station. The magnetic bearing representing the true bearing can be observed on the RMI (ID-998/ASN) by including the local magnetic variation. For VOR and TACAN, the course indicator can also be used by selecting the magnetic course which represents the true course. For example, with an easterly magnetic variation of 9.5°, the indicated magnetic bearing or selected magnetic course would be 350.5° or 170.5°.

1. POS FIX pushbutton – Press when the bearing pointer indicates the magnetic bearing that corresponds to a true bearing of 0° or 180° to the station. Note that the POS FIX indicator brightens.

2. DEST thumbwheel – Select number representing the station used for update.

3. STA pushbutton – Select STA indicator in (bright) program TACAN data. Select STA indicator out (dim) program destination data.

4. SELECT switch – EVAL. Read difference between known coordinates and computed coordinates of selected destination. Note that INSERT pushbutton brightens.

5. SR pushbutton – Press. Note that left display clears and INSERT pushbutton brightens.

6. INSERT pushbutton – Press. Note that INSERT and POS FIX indicators dim.

(2) North-South manual INS update using VOR, ADF, or TACAN stations can be accomplished by flying the aircraft so that it will cross the true 90° or 270° bearing to the station. The magnetic bearing representing the true bearing can be observed on the RMI (ID 998/ASN) by including the local magnetic variation. For VOR and TACAN, the course indicator-selector can also be used by selecting the magnetic course which represents the true course. For example, with a westerly magnetic variation of 14.5°, the indicator magnetic bearing or selected magnetic course would be 104.5° or 284.5°.

1. POS FIX pushbutton – Press when the bearing pointer indicates the magnetic bearing that corresponds to a true bearing of 90° or 270° to the station. Note that the POS FIX indicator brightens.

2. DEST thumbwheel – Select number representing the station used for update.

3. STA pushbutton – Select STA indicator in (bright) program TACAN data. Select STA indicator out (dim) program destination data.

4. SELECT switch – EVAL. Read difference between known coordinates and computed coordinates of selected destination.

5. SL pushbutton – Press. Note that left display clears and INSERT pushbutton brightens.

6. INSERT pushbutton – Press. Note that INSERT and POS FIX indicators dim.

(9) TACAN update of INS. Updating of the INS can be automatically accomplished by the TACAN in the following manner:

NOTE

When operating in the NAV position the aircraft's actual altitude must be programmed as often as practical (during climbs and descents altitude differential should not exceed 5000 ft.) to provide the most accurate updating capability.

1. With the INS aligned and in the NAV position and the TACAN control panel switch in the T/R position, the INS will be automatically updated by valid TACAN data from the channel selected on the TACAN control panel.

2. With the INS aligned and in the NAV position and the TACAN control panel switch in the AUTO position, the INS will be automatically updated by valid TACAN data from any TACAN station whose coordinates have been preprogrammed into the INS computer.

(10) To operate in the air data mode:

NOTE

The INS automatically switches to the air data mode when the INS platform malfunctions. This condition is indicated when the MAL and AD indicators illuminate. The air data mode may also be selected manually if the true airspeed transducer is installed.

1. MODE selector – AD.

2. To update local magnetic variation: Refer to step b *(1)* 6.

3. To update wind velocity and direction:

(1) SELECT switch – WIND.

(2) STA pushbutton switch – Press if STA indicator is on. Note that STA indicator dims.

(3) SL pushbutton switch – Press. Note that INSERT indicator brightens and left display clears.

(4) Applicable data entry pushbuttons – Press. Insert wind direction in degrees and tenths of a degree referenced to true north. Data will appear in left display.

(5) INSERT pushbutton – Press. Note that INSERT indicator dims and information in left display is correct.

(6) SR pushbutton – Press. Note that INSERT indicator brightens and right display clears.

(7) Applicable data entry pushbuttons – Press. Insert wind velocity in knots. Data will appear in right display.

(8) INSERT pushbutton – Press. Note that INSERT indicator dims and information in right display is correct.

(11) X10 Mode Procedure.

1. To add 10 meter accuracy to UTM coordinates.

(1) SELECT switch – UTM DEST or UTM POS.

(2) DEST thumbwheel – Select number representing the desired destination or TACAN.

(3) STA pushbutton – Select STA indicator in (bright) to program TACAN data. Select STA indicator out (dim) to program destination data. Note that left and right displays readout the coordinates of the desired destination or TACAN

(4) DIM pushbutton – Press. Note that AD indicator flashes and information in both displays has shifted one position to the left.

(5) SL pushbutton – Press. Note that left display clears and INSERT indicator brightens.

(6) Keyboard pushbuttons – Press E/6 and the pushbutton representing the desired 10 meter number. Note that E and the 10 meter digit appear in the left display.

(7) INSERT pushbutton – Press. Note that INSERT indicator dims and that easting coordinates are on the left display but are shifted one position to the left.

(8) SR pushbutton – Press. Note that right display clears and INSERT indicator brightens.

(9) Keyboard pushbutton – Press N/2 for northing or S/8 for southing and the pushbutton representing the desired 10 meter number. Note that N or S and the 10 meter digit appear in the right display.

(10) INSERT pushbutton – Press. Note that INSERT indicator dims and that easting coordinates are on the right display but are shifted one position to the left.

(11) DIM pushbutton - Press. Note AD indicator stops flashing and the information on both displays has shifted back to normal display.

2. To add one one-hundredth minute accuracy to L/L.

(1) SELECT switch - L/L DEST or L/L POS.

(2) DEST thumbwheel - Select number representing the desired destination or TACAN.

(3) STA pushbutton - Select STA indicator in (bright) to program TACAN data. Select STA indicator out (dim) to program destination data. Note the left and right displays readout the coordinates of the desired destination or TACAN.

(4) DIM pushbutton - Press. Note that AD indicator flashes and information in both displays has shifted one position to the left.

(5) SL pushbutton - Press. Note that left display clears and INSERT indicator brightens.

(6) Keyboard pushbuttons - Press E/6 or W/4 and the pushbutton representing the desired 1/100 of a minute of longitude. Note that E or W and the digit representing 1/100 minute appear in left display.

(7) INSERT pushbutton - Press. Note that INSERT indicator dims and that longitude coordinates are on left display but are shifted one position to the left.

(8) SR pushbutton - Press. Note that right display clears and INSERT indicator brightens.

(9) Keyboard pushbuttons - Press N/2 or S/8 and the pushbutton representing the desired 1/100 of a minute of latitude.

(10) INSERT pushbutton - Press. Note that INSERT indicator dims and that latitude coordinates are on right display but are shifted one position to the left.

(11) DIM pushbutton - Press. Note AD indicator stops flashing and the information on both displays has shifted back to normal display.

3. To obtain X10 readouts from the INS:

(1) SELECT switch - UTM DEST, UTM POS, L/L DEST, L/L POS or EVAL as desired.

(2) DEST thumbwheel - Select number representing the desired destination or TACAN.

(3) STA pushbutton - Select STA indicator in (bright) to display TACAN data. Select STA indicator out (dim) to display destination data. Note that left and right displays readout the coordinates of the desired destination or TACAN.

(4) DIM pushbutton - Press. Note AD indicator flashes and information in both displays has shifted one position to the left. The right digit in both displays represents the 10 meter (UTM, EVAL) or 1/100 minute (L/L) data of the desired coordinate data.

(5) DIM pushbutton - Press. Note AD indicator stops flashing and the information on both displays has shifted back to normal display.

(12) Shutdown procedure:

1. Aircraft - Ensure that aircraft is parked in a fixed position.

2. INS data - Record as required (time in NAV, velocity errors, terminal error, etc.)

3. HDG MEM - Press. Hold pushbutton until MEM indicator brightens.

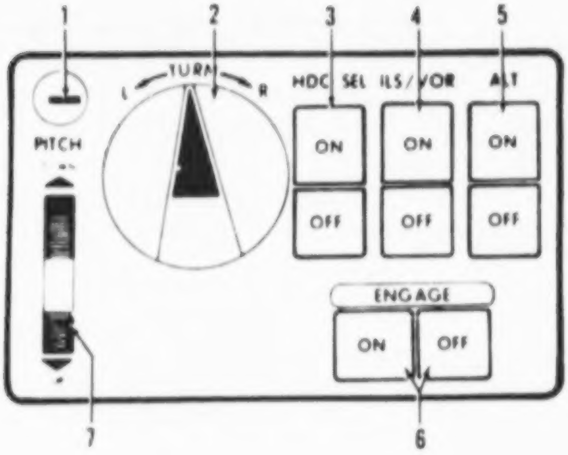
4. MODE selector - OFF.

3-30. TAS Transducer And Probe.

The TAS transducer supplies aircraft true airspeed information to the INS computer. This information is used in computations, and may also be displayed on the INS control-indicator. The TAS probe supplies air temperature information to the TAS transducer.

3-31. Autopilot RU-21A

The autopilot provides three-axis stability augmentation, pitch trim, heading holding, turn command, and lift compensation in turns. The



1. PITCH trim indicator
2. TURN control
3. HDG SEL switch
4. ILS/VOR switch
5. ALT switch
6. ENGAGE switch
7. PITCH trim control

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Figure 3-22. Autopilot Flight Controller (RU-21A)

autopilot can be used in conjunction with the VOR and marker beacon-glideslope receivers to provide automatic control during VOR and ILS operations. In addition, the autopilot can be used in conjunction with the INS to provide inertial intercept (A/P INS INTCP) and inertial direct (A/P INS DIR) operations.

NOTE

The autopilot is not usable unless the INS is installed and operating.

a. Autopilot Flight Controller Functions (fig. 3-22).

CONTROL	FUNCTION
PITCH trim indicator	Prior to autopilot engagement gives autopilot trim indications relative to aircraft trim. After autopilot engagement, indicates operation of the automatic trim system (trim motor).
TURN control	Allows the pilot to manually establish bank angles up to 30 degrees. The TURN control takes priority over all other heading functions.
HDG SEL switch	Controls the heading selector heading preselect command from the autopilot heading selector.
ILS/VOR switch	Applies steering error signals from the marker beacon-glideslope, VOR receivers, or the INS, to the autopilot computer. The signals are applied from the marker beacon-glideslope and/or VOR receivers when the pilot's COURSE IND switch (para. 5-51), is in the VOR position. The signals are applied from the INS when the pilot's COURSE IND switch is in the A/P INS INTCP or A/P INS DIR position.
ALT switch	Causes the autopilot to keep the aircraft at the pressure altitude at which the aircraft is flying at the time of engagement.
ENGAGE switch	Controls operating power to the autopilot computer.
PITCH trim switch	Establishes climb or descent attitudes during autopilot operations. Disengages the altitude hold mode when a climb or descent command is initiated.

b. Autopilot Heading Selector Functions (fig. 2-36).

CONTROL	FUNCTION
Heading select control	Preselects a heading when the HDG SEL switch is disengaged. Selects a heading or operates as a

	turn control when the HDG SEL switch is engaged.
Index	Indicates heading selected by heading select control.

c. Autopilot Disengage And Back Course Switch Functions. The autopilot disengage switch, placarded A/P, is located on the outboard grip of the pilot's control wheel. The autopilot back course switch, placarded AP BACK COURSE, is located on the control pedestal extension.

CONTROL	FUNCTION
A/P disengage	Disengages and turns off the autopilot.
A/P BACK COURSE switch	When engaged by pressing (placard light comes on), reverses localizer inputs to autopilot to allow an ILS back course approach using the autopilot. When switch is disengaged by pressing it again (placard light goes out), autopilot can be used for an ILS front course approach.

d. Autopilot Turn And Slip Indicator Functions (fig. 2-36).

INDICATOR	FUNCTION
Turn indicator	Indicates direction and rate of turn or slip.
Slip indicator	Indicates slips or skids.

e. Autopilot Operation. The operating procedures for the autopilot are outlined in the following paragraphs:

NOTE

Do not operate the autopilot unless the INS is installed and operating.

f. Autopilot Alignment and Engaging.

NOTE

Do not use autopilot below 300 feet above ground level in any configuration.

NOTE

Do not use autopilot for a single-engine approach as you may exceed the limitations of the autopilot.

(1) Preparation for engaging:

1. Aircraft trim tab controls – TRIM. Manually trim aircraft.

2. Pitch thumbwheel and PITCH indicator (autopilot flight controller, fig. 3-22) – CENTER. Center pitch indicator.

3. TURN control (autopilot flight controller) – CENTER. Place in center detent position.

(2) To engage autopilot: ENGAGE switch (autopilot flight controller) – ON.

g. Autopilot Maneuvering in Flight.

(1) To adjust pitch: Pitch thumbwheel (autopilot flight controller) – UP or DOWN, as required.

(2) To adjust bank: TURN control (autopilot flight controller) – L or R, as required.

NOTE

Maximum pitch adjustment is 20 degrees up or down. Maximum bank adjustment is 30 degrees left or right.

(3) To adjust for level flight:

1. PITCH indicator (autopilot flight controller) – CENTER. Center with pitch thumbwheel.

2. Bank indicator (autopilot turn and slip indicator) – CENTER. Center using turn control.

h. Autopilot Heading Selection.

(1) To maintain a heading: TURN control (autopilot flight controller) – CENTER. Place in center detent position.

(2) To preselect a heading: Heading select control (autopilot heading selector) – SELECT. Select required heading.

(3) To fly preselected heading: HDG SEL switch (autopilot flight controller) – ON. Aircraft will automatically bank, turn, and roll out on selected heading.

(4) To select a new heading: Heading select control (autopilot heading selector) – SELECT NEW HEADING. Aircraft will bank and turn in direction heading select control is turned and roll out on new heading.

i. Autopilot Altitude Control Operation.

(1) To maintain an altitude:

1. Pitch thumbwheel and PITCH indicator (autopilot flight controller) – ADJUST. Level off aircraft at required altitude.

2. ALT switch – ON.

NOTE

If the ALT switch is engaged during a nominal climb or descent, the aircraft will level off slightly beyond the selected altitude. Then, when the ALT switch is disengaged, the aircraft will resume the climb or descent angle existing at the time the ALT switch was engaged.

(2) To select a new altitude:

1. ALT switch (autopilot flight controller) – OFF.

2. Pitch thumbwheel – UP or DOWN, until required altitude is reached.

3. PITCH indicator – CENTER. Center after required altitude is reached.

4. ALT switch – ON.

j. Autopilot VOR Operation.

(1) Preliminary procedures:

1. NAV-COMM control panel (fig. 3-14) – TUNE. Tune in desired VOR station (para. 3-23b.).

2. Pilot's COURSE IND switch (instrument panel, fig. 2-36) – AS REQUIRED.

3. Copilot's course indicator-selector (fig. 3-10) – SET. Set OBS control to required course.

4. Heading select control (autopilot heading selector, fig. 2-36) – SET. Set to required course.

NOTE

For best performance, allow approximately 30 seconds after setting the OBS control before proceeding.

(2) To intercept the required course (radial): ILS/VOR switch (autopilot flight controller, fig. 3-22) – ON. The aircraft will automatically turn to a 45 degree intercept of the selected inbound or outbound course.

NOTE

When the aircraft is within 10 degrees of the selected radial, it will begin a gradual intercept of the radial. When passing the VOR station, a smooth bank in each direction will be noted before tracking outbound.

(3) To track outbound within 30 degrees of the inbound heading:

1. Heading select control (autopilot heading selector) – SELECT. Select outbound course.

2. OBS control (copilot's course indicator-selector) – SELECT. Select heading of outbound radial. Aircraft automatically tracks outbound radial.

(4) To track outbound beyond 30 degrees of the inbound heading:

1. TURN control (autopilot flight controller) – TURN. Turn aircraft to parallel required course. ILS/VOR switch will disengage.

2. Heading select knob (autopilot heading selector) – SELECT. Select heading of outbound course.

3. OBS control (copilot's course indicator-selector) – SELECT. Select heading of outbound course.

4. ILS/VOR switch (autopilot flight controller) – ON. Aircraft automatically intercepts and tracks outbound radial.

(5) To track inbound to next VOR station:

1. NAV-COMM control panel – TUNE. Tune in next VOR station (para. 3-23b.).

2. Heading select control (autopilot heading selector) – SELECT. Select new course.

3. OBS control (copilot's course indicator-selector) – SELECT. Select new course.

(6) To disengage automatic VOR operation: Automatic VOR operation may be disengaged by any of the following methods:

1. TURN control (autopilot flight controller) – ADJUST. Move from center detent position.

2. ILS/VOR switch – OFF.

3. HDG SEL switch – ON.

k. Autopilot ILS Approach (Front Course).

(1) Preliminary procedures:

1. ILS/VOR switch (autopilot flight controller, fig. 3-22) – OFF.

2. NAV-COMM control panel (fig. 3-13) – TUNE. Tune in desired localizer station (para. 3-23b.).

3. Marker beacon-glideslope receiver (fig. 2-38) – ON. (para. 3-24a.)

4. Pilot's COURSE IND switch (instrument panel) – VOR.

5. A/P BACK COURSE switch (control pedestal, fig. 2-11) – OFF. Light not on.

(2) Approach procedure.

1. Heading select control (autopilot heading selector, fig. 2-35) – SELECT. Select required course (inbound or outbound).

2. HDG SEL switch (autopilot flight controller, fig. 3-22) – ON.

3. Pitch control – AS REQUIRED (to descend to the procedure turn altitude and level off).

4. ALT switch – ON.

5. TURN control – AS REQUIRED.

6. Glideslope indicator (pilot's course indicator-selector, fig. 2-36) – OBSERVE. Needle will begin to deflect.

7. TURN control (autopilot flight controller) – ADJUST. Return to center detent position.

8. ILS/VOR switch – ON. Aircraft brackets glideslope beam.

9. Glideslope indicator (pilot's course indicator-selector) – CENTERED.

10. ALT switch – DISENGAGED (automatically disengaged).

11. Power levers – ADJUST.

12. A/P switch (pilot's control wheel) – PRESS. Press when approaching minimum descent altitude. Complete touch-down manually.

l. Autopilot ILS Approach (Back Course). The back course autopilot approach is the same as the front course approach except as follows:

(1) A/P BACK COURSE switch (control pedestal) – ENGAGE. Engage when approaching inbound heading on ILS backcourse.

(2) Pitch thumbwheel (autopilot flight controller) – ADJUST. Use to control descent after landing gear is down.

(3) A/P switch (pilot's control wheel) – PRESS. Press when approaching minimum descent altitude. Complete touchdown manually.

Section IV. TRANSPONDER AND RADAR

3-32. Description.

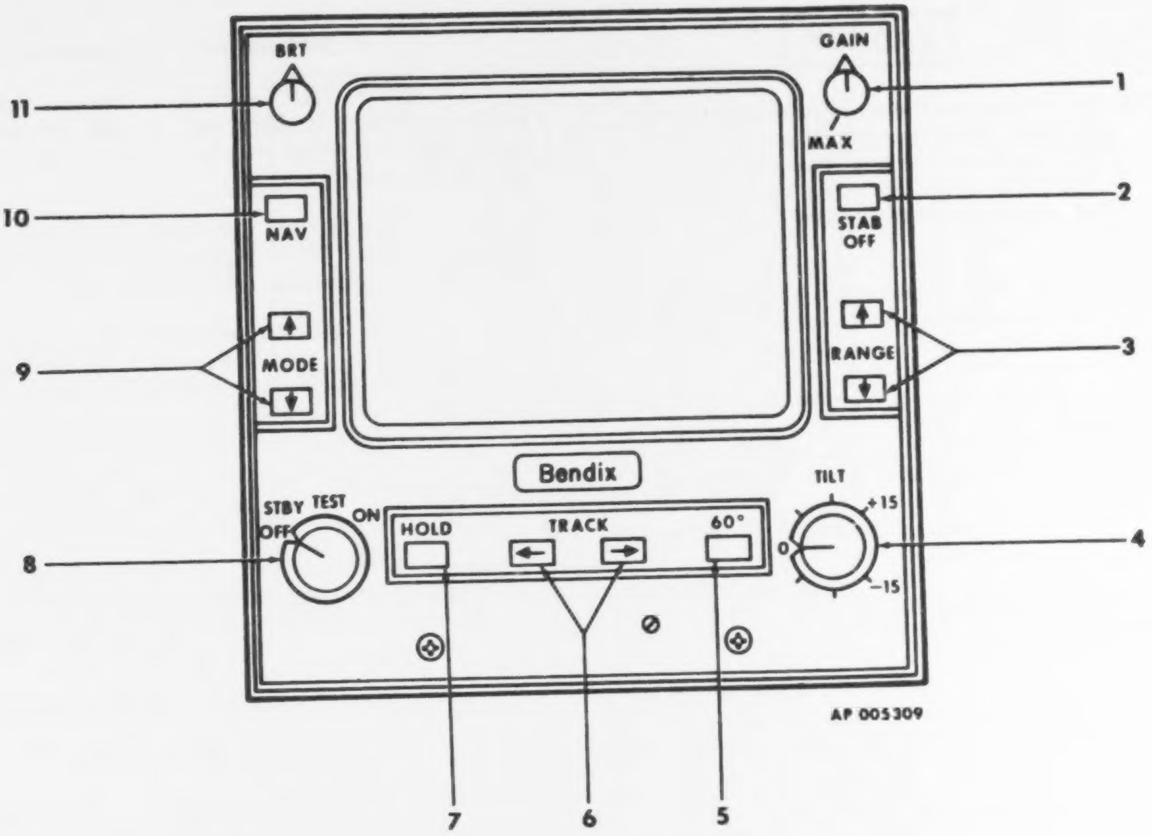
The transponder provides an identification, position and emergency tracking system. The radar system locates potentially dangerous weather areas.

3-33. Weather Radar Set (AN/APN-215(V)1).

The weather radar set provides a visual presentation of the general sky area of approximately 120 degrees around the nose of the aircraft and extending to a distance of 240 nautical miles. The presentation on the screen (fig. 3-23) shows the location of potentially dangerous areas, such as thunderstorms and hailstorms, in terms of distance and azimuth with respect to the aircraft. The radar is also capable of ground mapping operations. The radar antenna stabilization signals are supplied by the vertical gyro. There are no front panel fuses or circuit breakers provided for the weather radar set.

a. Weather Radar Control/Indicator Functions (fig. 3-23).

CONTROL/ INDICATOR	FUNCTION
GAIN control	Used to adjust radar receiver gain in the MAP mode only.
STAB OFF switch	Push on/push off type switch. Used to control antenna stabilization signals.
RANGE switches	Momentary action type switches. When pressed, clears the screen and increases or decreases the range depending on switch pressed.
TILT control	Varies the elevation angle of radar antenna 15 degrees up or down from horizontal attitude of aircraft.
60° switch	Push on/push off type switch. When activated, reduces antenna scan from 120 degrees to 60 degrees.
TRACK switches	Momentary action type switches. When activated, a yellow track line extending from the apex of the display through top range mark appears and moves either left or right, depending on the switch pressed. The track line position will be displayed in degrees in the upper left corner of the screen. The line will disappear approximately 15 seconds after the switch is released. It will then automatically return to 0 degrees.
HOLD switch	Push on/push off type switch. When activated, the last image presented before pressing the switch is displayed and held. The word HOLD will flash on and off in the upper left corner of the screen. Pressing the switch again will update the display and resume normal scan operation.
Function switch	Controls operation of the radar set.
OFF	Turns set off.
STBY	Places set in standby mode. This position also initiates a 90 second warmup delay when first turned on.
TEST	Displays test pattern to check for proper operation of the set. The transmitter is disabled during this mode.
ON	Places set in normal operation.
MODE switches	Momentary action type switches. Pressing and holding either switch will display an information list of operational data on the screen. The data heading will be in blue, all data except present data will be in yellow and present selected data will show in blue. The three weather levels will be displayed in red, yellow and green. If WXA mode has been selected, the red bar will flash on and off. If the switch is released and immediately pressed again, the mode will increase or decrease



1. GAIN control/switch
2. STAB OFF switch
3. RANGE switches
4. TILT control
5. 60° scan switch
6. TRACK switches
7. HOLD switch
8. Function switch
9. MODE select switches
10. NAV switch
11. BRT control

Figure 3-23. Weather Radar Control/Indicator (AN/APN-215 (V)1)

	depending on switch pressed. When either top or bottom mode is reached, the opposite switch must be pressed to further change the mode.
NAV switch	The words NO NAV will be displayed in the lower left corner unless the indicator is supplied with navigation data from other avionics not covered by this manual.
BRT control	Used to adjust screen brightness.

b. *Weather Radar Set Operation.*

WARNING

Do not operate the weather radar set while personnel or combustible materials are within 18 feet of the antenna flat plate array. When the weather radar set is operating, high-power radio-frequency energy is emitted from the antenna flat plate array which can have harmful effects on the human body and can ignite combustible materials.

CAUTION

Do not operate the weather radar set in a confined space where the nearest metal wall is 50 feet or less from the antenna flat plate array. Scanning such surfaces may damage receiver crystals.

(1) Turn-on procedure: Function switch – TEST or ON as required (information will appear after time delay period has elapsed).

(2) Initial adjustments operating procedure:

1. BRT control – As required.

2. MODE switches – Press and release as required.

3. RANGE switches – Press and release as required.

4. TILT control – Move up or down to observe targets above or below aircraft level. The echo display will change in shape and location only.

(3) Test procedure:

1. Function switch – TEST.

2. RANGE switches – Press and release as required to obtain 80 mile display.

3. BRT control – As required.

4. Screen – Observe for proper display. The test display consists of two green, two yellow and a red band on a 120 degree scan. The word TEST will be displayed in the upper right corner. The operating mode selected by the MODE switches, either MAP, WX or WXA, will be displayed in the lower left corner. If WXA has been selected, the red band in the test pattern will flash on and off. The range will be displayed in the upper right corner beneath the word TEST and appropriate range mark distances will appear along the right edge of the screen.

(4) Weather observation operating procedure:

1. Function switch – ON.

2. MODE switches – Press and release as required to select WX.

3. BRT control – As required.

4. TILT control – Adjust until weather pattern is displayed. Include the areas above and below the rainfall areas to obtain a complete display.

5. MODE switches – Press and release to select WXA. Areas of intense rainfall will appear as flashing red.

6. TRACK switches – Press to move track line through area of least weather intensity. Read relative position in degrees in upper left corner of screen.

NOTE

Refer to TM 11-5841-289-13 for both weather and ground mapping functions of radar set AN/APN-215(V)1.

(5) Ground mapping operating procedure:

1. Function switch – ON.

2. MODE switches – Press and release as required to select MAP.

3. BRT control – As required.

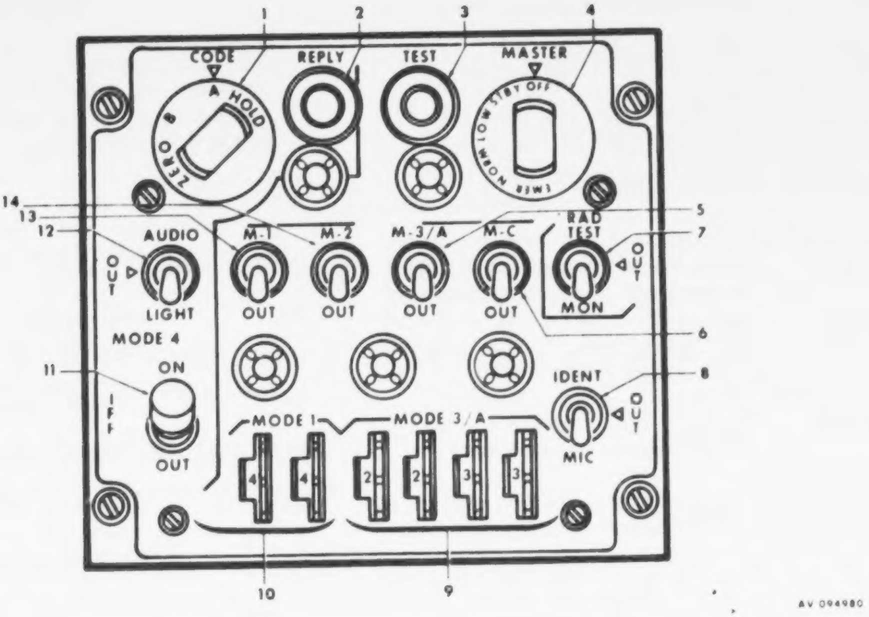
4. GAIN control – As required to present usable display.

(6) Standby procedure: Function switch – STBY.

(7) Shutdown procedure: Function switch – OFF.

3-34. Transponder Set (AN/APX-72).

The transponder set (fig. 3-24) is an identification, position tracking, and emergency tracking device. This set receives, decodes, and responds to, interrogations by search radar. It operates in conjunction with TS-1843A/APX inflight test set which provides a self test feature and the Kit-1A/TSEC computer which provides the mode 4 feature. Power for the transponder set, Kit-1A/TSEC and TS-1843A/APX, is fed through the 50-ampere AVIONICS No. 1 and AVIONICS No. 2 circuit breakers on the copilot's circuit breaker panel. The transponder, computer, and test set are



1. CODE control
2. REPLY light
3. TEST light
4. MASTER control
5. M3/A switch
6. M-C switch
7. RAD TEST-MON switch
8. IDENT-MIC switch
9. MODE 3/A code selectors
10. MODE 1 code selectors
11. MODE 4 ON-OUT switch
12. MODE 4 AUDIO-LIGHT switch
13. M-1 switch
14. M-2 switch

Figure 3-24. Transponder Control Panel (AN/APX-72)

protected by the 10-ampere XPDR circuit breaker located on the right subpanel.

a. Transponder Control Panel Functions (fig. 3-21).

CONTROL	FUNCTION
CODE control	Selects mode 4 code of the day, A or B.
HOLD	Prevents zeroizing when power is removed from set or MASTER control is turned OFF.
A	Selects keyed in code A.
B	Selects keyed in code B.
ZERO	Erases codes A and B (zeroize).
REPLY light	Indicates valid mode 4 interrogations and replies when MODE 4 AUDIO LIGHT switch is in AUDIO or LIGHT positions.
TEST light	Indicates the proper response has been generated when the M-1, M-2, M-3/A, and M-C switches are placed in TEST position. Also illuminates when RAD TEST-MON switch is in MON position and replies are made to M-1, M-2 or M-3/A interrogations.
MASTER control	
OFF	Turns set off.
STBY	Places set in warm-up (standby) condition.
LOW	Places set at low sensitivity.
NORM	Operates set at normal sensitivity.

EMER	Transmits emergency reply.

M-1, M-2, M-3/A, and M-C switches

ON	Permits set to reply in the selected mode.
OUT	Disables replies.
TEST	Permits self test in the selected mode when test set 1843A/APX is installed. The transponder set can also reply to ground interrogations in the selected mode while being tested.
M-1 and M-2	Response to military identification interrogation.
M-3/A	Response to civilian identification interrogation.
M-C switch	Reponse to Mode C interrogations.

RAD TEST-MON switch

RAD TEST	Enables an appropriately equipped transponder to reply to TEST mode interrogations from an AN/UPM-92, or similar test set.
MON	Turns on circuits in the transponder test set to monitor for proper replies to M-1, M-2 or M-3/A interrogation.
OUT	Disables both test features.

IDENT-MIC switch

IDENT	Activates identification feature.
MIC	Inoperative in this installation.
MODE 1 and MODE 3/A code selectors	Selects the desired reply codes for modes 1 and 3/A.

NOTE

MODE 2 code selector is located on the transponder receiver-transmitter and should be set prior to flight when required.

NOTE

The transponder computer must be installed in order for the AN/APX-72 transponder set to make a reply to a mode 4 interrogation.

MODE 4 ON-OUT switch

ON	Permits transponder set to decode a mode 4 interrogation.
OUT	Disables mode 4 decoding.

MODE 4 AUDIO LIGHT switch

AUDIO	Permits aural and reply light monitoring of valid mode 4 interrogations and replies.
LIGHT	Permits only REPLY light monitoring.

b. IFF Caution Light. The function of the IFF caution light (fig. 2-36 or 2-37), placarded IFF CAUTION, is as follows:

INDICATOR	FUNCTION
IFF	Indicates that the transponder set has failed to reply to a valid mode 4 interrogation. It also lights when the MODE 4 codes have been zeroized.

c. Transponder Set Operation. If mode 4 operation is required, perform the following procedures after the landing gear has been retracted.

NOTE

MODE 2 code selectors are located on the transponder receiver-transmitter and should be set prior to flight when required.

NOTE

To prevent zeroizing the Mode 4 function of the AN/APX-72 transponder, when the landing gear is down and the struts compressed, place the CODE control momentarily in HOLD position before either transponder or aircraft power is turned off. CODE HOLD condition will only be removed when the struts are extended and the MASTER control is not in OFF position.

(1) Turn-on procedure: MASTER control – STBY (allow 2 minutes warmup).

(2) Modes 1, 2, 3/A, C, and/or 4 operating procedure:

1. MASTER CONTROL – LOW or NORM. Set for required receiver sensitivity.

2. M-1, M-2, M-3/A, M-C, and/or MODE 4 ON-OUT switches – On. Actuate only those switches corresponding to the required codes. The remaining switches should be left in the OUT position.

3. MODE 1 code selectors – Set (if applicable).

4. MODE 3/A code selectors – Set (if applicable).

5. CODE control – Set (as required).

6. RAD TEST-MON switch – MON (if desired).

7. TEST light – Monitor to determine when transponder set is replying to an SIF interrogation.

8. MODE 4 AUDIO LIGHT switch – Set (as required to monitor mode 4 interrogations and replies).

9. AUDIO and/or REPLY light – Listen and/or observe (for mode 4 interrogations and replies).

10. IFF CAUTION light (instrument panel) – Monitor for an indication (will illuminate if transponder fails to reply to a mode 4 interrogation or when the MODE 4 codes have been zeroized).

NOTE

If IFF CAUTION light illuminates, check the position of the MODE 4 ON-OUT switch immediately. If the switch is in the ON position, establish contact with the interrogating station on a communications set and explain the situation.

(3) To test transponder set operation in code modes 1, 2, C, and/or 3/A:

NOTE

The following self-tests will not prevent transponder set replies to external interrogations. Test only those modes that are being used.

1. M-1, M-2, M-3/A and/or M-C switches – Momentarily set switches to test position, one at a time.

2. TEST light – Observe for indication as each code switch is held in TEST position. If TEST light fails to light, recheck applicable control settings. If the light does not illuminate after the control settings have been rechecked, either the transponder or the self-test feature is faulty.

(4) Transponder set identification-position operating procedure: The transponder set can make identification-position replies while operating in code modes 1, 2, and/or 3/A, in response to ground station interrogations. This type of operation is initiated by the operator as follows:

1. Modes 1, 2 and/or 3/A – Operating.

2. IDENT-MIC switch – Press momentarily to IDENT, when directed.

NOTE

Holding circuits within the transponder receiver-transmitter will transmit identification-position signals for approximately 30 seconds. This is normally sufficient time for ground control to identify the aircraft's position. During this 30-second period, it is normal procedure to acknowledge via the aircraft communications set that identification-position signals are being generated.

(5) Shutdown procedure:

NOTE

To prevent zeroizing the MODE 4 function of the transponder, when the landing gear is down and the struts compressed, place the CODE control momentarily in HOLD position before either transponder or aircraft power is turned off. CODE HOLD condition will only be removed when the struts are extended and the MASTER control is not in OFF position.

1. CODE control – HOLD (when required to hold MODE 4 code).

2. MASTER control – OFF.

d. Transponder Set Emergency Operation.

NOTE

The MASTER switch on the transponder control panel shall be placed in the EMER position only under emergency conditions.

(1) Modes 1, 2, and/or 3/A – Operating.

(2) Master switch – EMER.

3-35. Pilot's Encoding Altimeter, AAU-32/A.

The encoder/pneumatic altimeter (fig. 3-25) provides the pilot with an indication of his present altitude in addition to providing the transponder altitude information for use in Mode C. This pneumatic counter-drum/pointer altimeter is a self contained unit which consists of a sensitive pressure altimeter combined with an altitude encoder. The display indicates and the encoder transmits, simultaneously, pressure altitude reporting to ground stations. The altimeter is protected by a 1-ampere ALTIMETER circuit breaker on the right subpanel.

a. Encoding Altimeter Control-Indicator Functions (fig. 3-25).

CONTROL	FUNCTION
Barometric Set knob	Permits setting desired barometric pressure in inches Hg.
10,000 foot counter drum	Indicates aircraft altitude in ten thousands of feet.
1,000 foot counter drum	Indicates aircraft altitude in thousands of feet.
Single-needle pointer	Indicates aircraft altitude in hundreds of feet in twenty foot increments.
Diagonal warning symbol	Appears on the 10,000 foot counter when aircraft is below an altitude of 10,000 feet.
Code off flag (red)	Presence in upper left portion of instrument face indicates altitude encoder is inoperative and the system is not operating, or the code flag has failed.
IN. Hg. window	Indicates barometric pressure in inches of mercury as adjusted by the barometric set knob.

b. Encoding Altimeter Operation.

(1) Turn-on procedure:

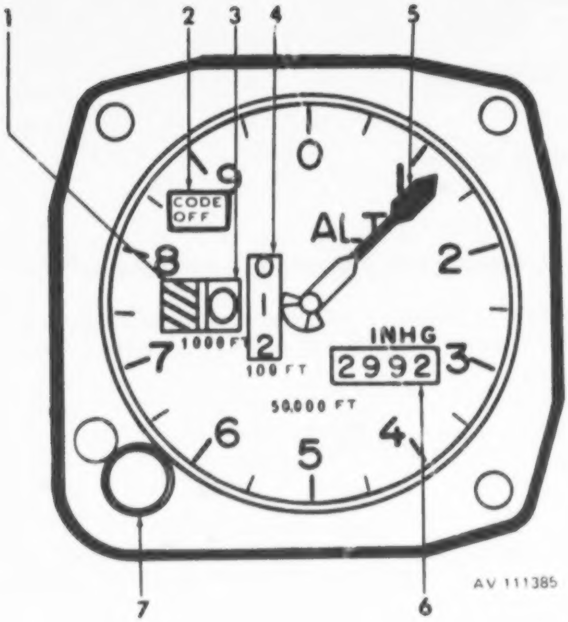
1. Battery switch – ON.

2. Altimeter Circuit Breaker – Set.

3. Transponder Mode C Switch (M-C) – On (for Flight Altitude Reporting).

(2) Operating Procedure:

1. Barometric set knob – Set desired barometric pressure in IN. Hg. window.



1. 10,000 foot counter drum
2. CODE OFF flag
3. 1,000 foot counter drum
4. 100 foot counter drum
5. Single needle pointer
6. IN. HG. window
7. Barometric set knob

Figure 3-25. Encoding Altimeter Indicator (AAU-32/A)

NOTE

A minimum of one minute warm-up time is required prior to setting or checking altimeter operation.

NOTE

If the barometric set knob binds or sticks, abnormal force should not be used to make the setting as this may cause internal gear failure resulting in an altitude error. Settings can sometimes be made by backing off and turning at a slower rate.

2. CODE OFF flag – Check (not visible.

NOTE

If the CODE OFF flag is visible, either DC power is off, the circuit breaker is not set, or there is an internal altimeter encoder failure, since the CODE OFF flag monitors only the encoder function of the altimeter and not transponder condition. The altitude reporting function may be inoperative without the CODE OFF flag showing, in case of transponder failure or improper control settings. It is also possible to get a good Mode C test on the transponder control with the CODE OFF flag showing. If the CODE OFF flag remains visible, radio contact should be made with a ground radar site to determine if the altitude reporting function is operative.

3. Single-needle pointer – Check operation.

NOTE

The altimeter is equipped with a DC powered internal vibrator which is required to overcome friction and assure accuracy. If the vibrator becomes inoperative due to internal failure or DC power failure, the pointer may momentarily hang up when passing from "9" through "0" while climbing, or from "0" through "9" while descending. This hang up will cause lag, the magnitude of which will depend on the vertical speed of the aircraft and the friction in the altimeter. Pilots should be especially watchful for this type failure when the minimum approach altitude lies within the "8" to "1" part of the scale 800-1100, 1800-2100, etc.

NOTE

If the altimeter does not read within 70 feet of field elevation when the correct local barometric setting is used, the altimeter needs re-zeroizing or internal failure has occurred. An error of greater than 70 feet also renders the altimeter unsuitable for IFR. Flight.

c. *Encoding Altimeter Emergency Operation.*

1. Altimeter circuit breaker – Pull (if encoder fault occurs).

CHAPTER 4

MISSION EQUIPMENT

Section I. MISSION AVIONICS

4-1. Mission Avionics Operating Instructions.

Operating instructions for mission avionics equipment in the RU-21A and RU-21D aircraft are published in TM 32-1510-209-12/2 (RU-21A) and (C) TM 11-5825-252-15 (RU-21D).

Section II. AIRCRAFT SURVIVABILITY EQUIPMENT

4-2. XM-130 Flare and Chaff Dispensing System. RU-21A

a. Description. The XM-130 flare and chaff dispensing system provides effective survival countermeasures against radar guided weapons systems and infrared seeking missile threats. The system consists of two dispenser assemblies with payload module assemblies, a dispenser control panel, a flare dispense switch, two control wheel mounted chaff dispensing switches, an electronic module assembly, and associated wiring.

WARNING

Right wing engine nacelle dispenser is for chaff only.

(1) Dispenser Assemblies. Two interchangeable dispenser assemblies are mounted on the aircraft. One is located in the aft portion of the right nacelle and the other is mounted on the right side of the fuselage. On this aircraft the dispenser in the nacelle will be used for chaff only while the dispenser mounted on the fuselage can be used for either flares or chaff. The selector switch (placarded C-F) on the dispenser can be set for either chaff or flares. The unit also contains the sensor for the flare detector. The dispenser assembly breech plate has the electrical contact pins which fire the impulse cartridges. The unit also contains the sequencing mechanism.

(2) Payload module assemblies. A removable payload module assembly is provided for each dispenser assembly. Each payload module has 30 chambers which will accept either flares or chaffs. Flares or chaffs are loaded into the rear-end (studded end) of the payload module, and secured in place by a retaining plate.

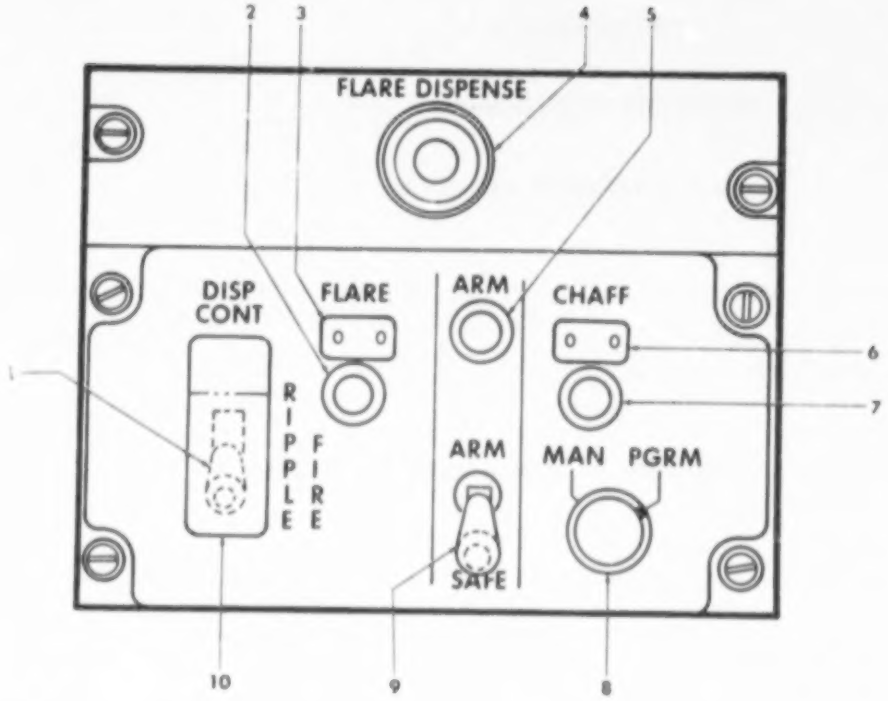
(3) Electronic module assembly (EM). The electronic module assembly contains the programmer, the flare detector and a safety switch. The unit is attached to the floor behind the copilot's seat.

(a) Flare detector. The flare detector is provided to insure that a flare is burning when it is ejected from the dispenser payload module. If the initial flare fails to ignite, the detector automatically fires another flare within 75 milliseconds. If the second flare fails to ignite, the detector will fire a third flare. If the third flare ignition is not detected, the detector will not fire another flare until the system is activated again by pressing the FLARE DISPENSE switch.

(b) Programmer. The programmer is used for the chaff mode only. It has four switches for setting count and interval of salvo and burst.

(c) Safety switch. The safety switch (with safety pin and red flag) prevents firing of chaff or flares when the safety pin is inserted. The safety pin shall be removed only while the aircraft is in flight or during test of the system.

(4) Flare dispenser switch. A single pushbutton switch placarded FLARE DISPENSE, located on the control pedestal, will fire a flare from the dispenser payload module each time it is pressed. If the FLARE DISPENSE switch is held down, it will dispense a flare every 2.3 seconds.



1. RIPPLE FIRE switch
2. Flare counter setting knob
3. FLARE counter
4. FLARE DISPENSE switch
5. ARM light
6. CHAFF counter
7. Chaff counter setting knob
8. Chaff selector switch
9. ARM-SAFE switch
10. RIPPLE FIRE switch cover

AP 002891

Figure 4-1. Flare/Chaff Dispenser Control Panel

(5) Control wheel mounted chaff dispense switches. Two pushbutton switches placarded CHAFF DISP, one located on top left portion of the pilot's control wheel and the other located on the top right portion of the copilot's control wheel, activates the chaff dispensing system when pressed.

(6) Wing mounted safety switch. A wing mounted safety switch (with safety pin and red flag) located on top of the right wing, just aft of the nacelle, prevents the firing of chaff or flares when the pin is inserted. This safety pin shall be inserted while the aircraft is on the ground and removed prior to flight or during system test.

(7) Dispenser control panel (DCP). The dispenser control panel (fig. 4-1) is mounted in the control pedestal. Control functions are as follows:

CONTROL	FUNCTION
ARM-SAFE switch	When in the SAFE position, power is removed from the XM-130 system. When in the ARM position, power is applied to the XM-130 system.
ARM light	An amber press to test indicator light placarded ARM illuminates when the ARM-SAFE switch is in the ARM position, when the safety pins are removed from the electronic module and the wing safety switch. Clockwise rotation will dim the indicator light.
RIPPLE FIRE switch	A guarded switch placarded RIPPLE FIRE fires all remaining flares when moved to the up position. It is used in the event of an inflight emergency to dispense all flares from the dispenser payload module.
FLARE counter	Indicates the number of flares remaining in the dispenser payload module.
FLARE counter setting knob	Facilitates setting FLARE counter to the number of flares in the payload module before flight.

CHAFF counter	Indicates the number of chaffs remaining in the payload module.
CHAFF counter setting knob	Facilitates setting CHAFF counter to the number of chaffs in the payload module before flight.

SELECTOR SWITCH

MAN	Bypasses the programmer and fires one chaff each time one of the chaff dispense switches is pressed.
PRGM	Chaff is fired in accordance with the preset chaff program as set into the electronic module (count and interval of bursts and salvo).

(8) Ammunition for dispenser. Ammunition for the system consists of countermeasure chaff M1, countermeasure flares M206, and impulse cartridges M796.

(a) Countermeasure chaff M1. These units consist of a plastic case 8 inches in length and 0.97 inches square. The base of the chaff case is flanged to provide one-way assembly into the dispenser payload module. The chaff consists of aluminum coated fiberglass strands.

(b) Countermeasure flare M206. These units consist of an aluminum case 8 inches in length and 0.97 inches square. The base of the flare is flanged to provide one-way assembly into the payload module. The flare material consists of a magnesium and teflon composition. A preformed packing is required in the base of the flare unit prior to inserting the impulse cartridge.

(c) Impulse cartridge M796. This cartridge fits into the base of either the flare or chaff and is electrically initiated to eject flares or chaff from the dispenser payload module.

b. Normal operation.

NOTE

If aircraft is to be flown with flare dispenser assembly removed, fairing should be removed from fuselage.

(1) General. At the present time surface-to-air intermediate range guided missiles that are launched against the aircraft must be visually detected by the aircraft crew. Crew members must insure visual coverage over the ground area where a missile attack is possible. The aircraft radar warning system will only alert the pilot and copilot when the aircraft is being tracked by radar-guided anti-aircraft weapons systems. It will not indicate the firing of weapons against the aircraft.

(2) Crew responsibilities. The pilot or designated crew member is responsible for removing the safety pin from the right wing before flight, and for replacing it immediately after flight. After the aircraft is airborne the pilot is responsible for removing the safety pin from the electronic module and moving the ARM-SAFE switch on the dispenser control panel to ARM. Before landing, he is responsible for re-inserting the safety pin in the electronic module and moving the ARM-SAFE switch to SAFE. While airborne the pilot and copilot are responsible for scanning the terrain for missile threats. When either pilot recognizes a missile launch he will press the FLARE DISPENSE button to eject flares.

(3) Conditions for firing. The dispenser system should not be fired unless a missile launch is observed or radar guided weapons system is detected and locked on. If a system malfunction is suspected, aircraft commander may authorize attempts to dispense flares or chaff as a test in a non-hostile area.

WARNING

Aircraft must be in flight to dispense flares.

(4) Firing procedure.

(a) Flares. Upon observing a missile launch the pilot or copilot (whoever sights the launch first) will fire a flare. If more than one missile launch is observed, the firing sequence should be continued until the aircraft has cleared the threat area.

(b) Chaff. Upon receiving an alert from the aircraft radar warning system, the pilot or copilot will fire the chaff and initiate an evasive manuever. The number of burst/salvo and number of salvo/program and their intervals as established by training doctrine will be set into the programmer prior to take-off (refer to TM 9-1095-206-13 & P for information on setting programmer). If desired, the operator may override the programmed operational mode and fire chaff

countermeasures manually by moving the dispenser function selector switch to MANUAL and pressing a dispenser switch.

(5) Firing Responsibility. When the pilot or copilot observes a missile launch or radar warning indication, he fires flares or chaff and assumes command of the dispenser system, and fires succeeding flares as required. He will advise the other pilot that a missile launch has been observed or a radar warning signal has been received, and announce that flares or chaff have been fired.

4-3. System Daily Preflight/Re-Arm Test. RU-21A

The following test procedures shall be conducted prior to the first flight of each day and prior to each re-arming of the dispensers. The first dispenser tested shall be the one used to dispense flares and the second one shall be the one used to dispense chaff. Notify AVUM if any improper indications occur during the tests.

WARNING

Assure payload module is not connected to dispenser assembly at any time during the following test procedures.

1. On flare dispenser assembly, assure the C-F selector switch is in F (flare) position.

2. Obtain M-91 test set and assure that TEST SEQUENCE switch is in START/HOME position.

3. Connect base plate of test set to breech of dispenser assembly. Secure both mounting studs uniformly hand tight, using 5/32 inch hexagonal wrench provided in test set carrying case.

4. Obtain test set power cable from the M-91 test set carrying case and connect cable between exterior connection J1 (28V DC) on aircraft (fig. 4-2) and aircraft power + 28V DC (J1) of test set.

5. Remove safety pin from EM and in the top skin of the right wing.

CAUTION

On DCP, assure that RIPPLE FIRE switch guard is in down position.

6. Provide aircraft power to DCP by setting XM-130 MAIN POWER BREAKER to ON position.

7. On DCP, press ARM lamp. Lamp will illuminate. Release ARM lamp. Lamp will extinguish.

8. On DCP, set FLARE counter to 30, CHAFF COUNTER to 30 and MAN-PRGM switch to MAN position.

9. On DCP, set ARM-SAFE switch to ARM. ARM lamp will illuminate.

NOTE

When the test set is installed on the dispenser assembly and 28 volts DC aircraft power has been applied, the sequencer switch inside of dispenser assembly resets, making an audible sound as it rotates. There will be no such sound if the sequencer switch has been previously reset or if switch is in position 12 or 24.

NOTE

On test set, TS PWR ON lamp (clear) illuminates and remains illuminated throughout the test sequence until aircraft power to test set (via test set power cable) is disconnected or shut off.

10. Set mission chaff program on EM.

11. Perform the following operations on the M-91 test set:

(1) Press to test the remaining three lamps on test set. Each lamp will illuminate.

NOTE

Replace any lamp that does not illuminate when pressed. If none of the indicating lamps illuminate, return test set to AVUM.

(2) Rotate TEST SEQUENCE switch clockwise to the next position, TS RESET. No visual indication will occur.

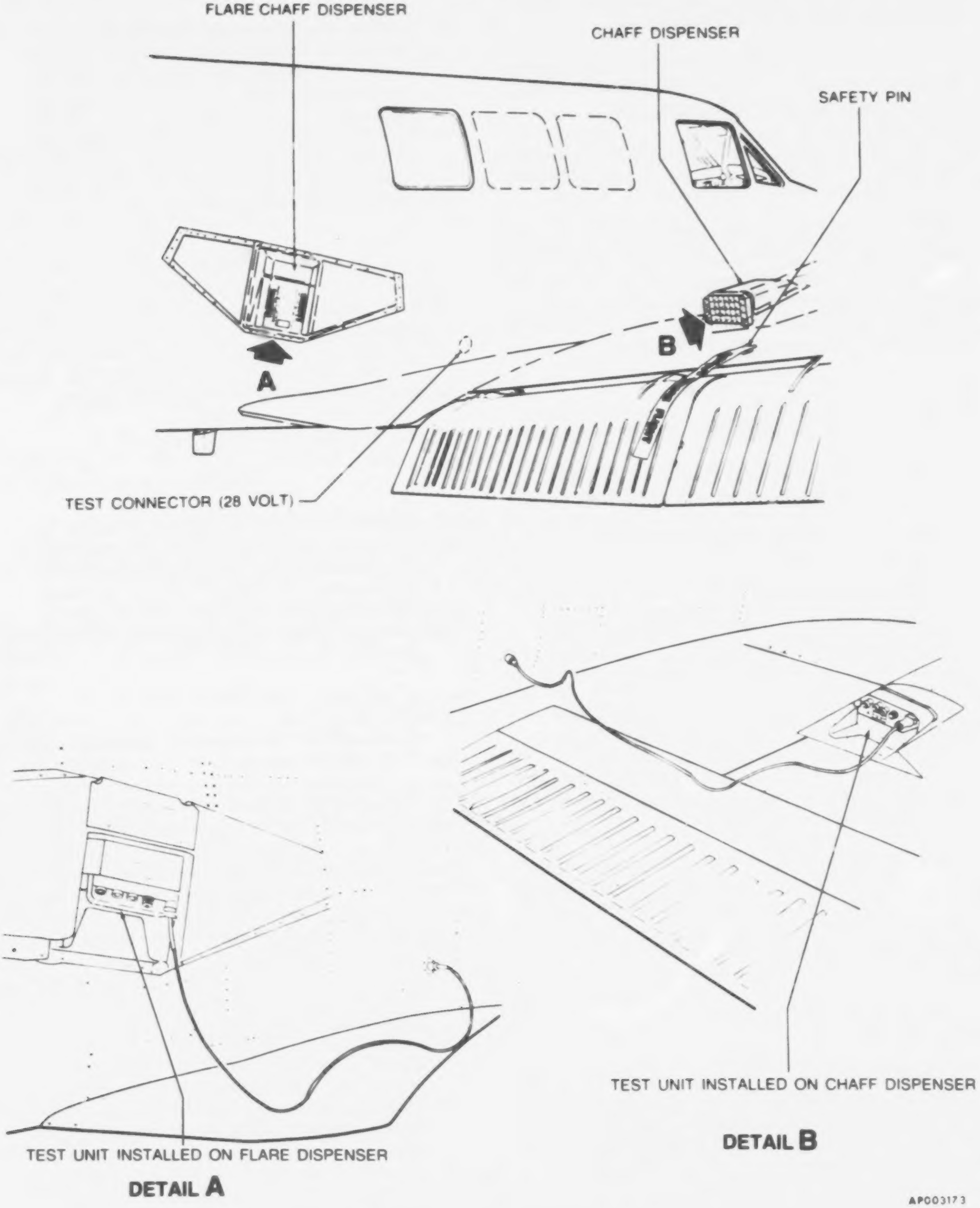


Figure 4-2. Flare/Chaff Dispenser Location and Test Unit Installation

(3) Rotate TEST SEQUENCE switch clockwise to SV SELF TEST position. STRAY VOLTAGE lamp (red) will illuminate.

(4) Rotate TEST SEQUENCE switch clockwise to next position, TS RESET. STRAY VOLTAGE lamp (red) will extinguish.

(5) Rotate TEST SEQUENCE switch clockwise to next position, STRAY VOLT. STRAY VOLTAGE lamp (red) should not illuminate.

(6) Rotate TEST SEQUENCE switch clockwise to next position, SYS NOT RESET. SYS NOT RESET lamp (amber) should not illuminate. If lamp illuminates, press and release MANUAL SYSTEM RESET switch and SYS NOT RESET lamp should then extinguish.

NOTE

When the MANUAL SYSTEM RESET switch is pressed and released, and 28 volts DC power has been applied, the sequencer switch inside the dispenser assembly resets, making an audible sound as it rotates. If the sequencer switch has been previously reset or if the switch is in position 12 or 24, there will be no such sound.

(7) Rotate TEST SEQUENCE switch clockwise to next position, DISP COMP.

12. Press FLARE DISP switch once. For each depressing, the FLARE counter on DCP should count down in groups of three.

13. On DCP, raise RIPPLE FIRE switch guard and set toggle switch to up position until FLARE counter counts down to 00. Return switch guard to down position. On DCP, reset FLARE counter back to 30. DISPENSER COMPLETE lamp (green) on test set will illuminate.

14. Perform the following operations on the M-91 test set:

(1) Rotate TEST SEQUENCE switch counter-clockwise to SYS NOT RESET position. SYS NOT RESET lamp (amber) will illuminate. DISPENSER COMPLETE lamp (green) will remain illuminated.

(2) Press and release MANUAL SYSTEM RESET switch. SYS NOT RESET lamp (amber) will extinguish.

NOTE

When the MANUAL SYSTEM RESET switch is pressed and released, and 28 volts DC power has been applied, the sequencer switch inside the dispenser assembly resets, making an audible sound as it rotates. If the sequencer switch has been previously reset or if the switch is in position 12 or 24, there will be no such sound.

(3) Rotate TEST SEQUENCE switch counterclockwise to STRAY VOLT position. STRAY VOLTAGE lamp (red) should not illuminate.

(4) Rotate TEST SEQUENCE switch counterclockwise to START/HOME position.

NOTE

When the TEST SEQUENCE switch is turned to the START/HOME position, the DISPENSER COMPLETE lamp will extinguish, the STRAY VOLTAGE lamp will illuminate and then will extinguish when passing through the TS RESET position.

15. On CHAFF dispenser assembly, assure that C-F selector switch is in C (chaff) position.

16. Remove XM-91 test set from first dispenser assembly.

17. Connect XM-91 test set to breech assembly of second dispenser assembly. Secure both mounting studs uniformly hand tight using ball hexagonal key screwdriver provided in test set carrying case.

NOTE

When the test set is installed on the dispenser assembly and 28 volts DC aircraft power has been applied, the sequence switch inside the dispenser assembly resets, making an audible sound as it rotates. There will be no such sound if the sequencer switch has been previously reset or if switch is in position 12 or 24.

NOTE

On test set, TS PWR ON lamp (clear) illuminates and remains illuminated through the test sequence until aircraft power to test set (via test set power-cable) is disconnected or shut off.

18. Perform the following operations on the M-91 test set:

(1) Press to test all four lamps on test set. Each lamp will illuminate.

NOTE

Replace any lamp that does not illuminate when pressed. If none of the indicating lamps illuminate, return test set to AVUM.

(2) Rotate TEST SEQUENCE switch clockwise to TS RESET position. No visual indication will occur.

(3) Rotate TEST SEQUENCE switch clockwise to SV SELF TEST position. STRAY VOLTAGE lamp (red) will illuminate.

(4) Rotate TEST SEQUENCE switch clockwise to next position, TS RESET. STRAY VOLTAGE lamp (red) will extinguish.

(5) Rotate TEST SEQUENCE switch clockwise to next position, STRAY VOLT. STRAY VOLTAGE lamp (red) should not illuminate.

(6) Rotate TEST SEQUENCE switch clockwise to next position, SYS NOT RESET. SYS NOT RESET lamp (amber) should not illuminate. If lamp illuminates, press and release MANUAL SYSTEM RESET switch and SYS NOT RESET lamp should then extinguish.

NOTE

When the MANUAL SYSTEM RESET switch is pressed and released, and 28 volts DC power has been applied, the sequencer switch inside the dispenser assembly resets, making an audible sound as it rotates. If the sequencer switch has been previously reset or if the switch is in position 12 or 24, there will be no such sound.

(7) Rotate TEST SEQUENCE switch clockwise to next position, DISP COMPL.

19. Press pilot CHAFF DISP switch once. Press copilot CHAFF DISP switch once. On DCP, for each depressing, the CHAFF counter should count down by an increment of one.

20. On DCP, set MAN-PRGM switch to PRGM position.

21. Press any one of CHAFF DISP switches in aircraft. On DCP, the number shown on CHAFF counter should decrease in accordance with the program set on the EM.

22. Repeatedly press other CHAFF DISPENSE switch until CHAFF counter on DCP reads 00.

23. On test set, observe DISPENSE COMPLETE lamp (green) is illuminated and then perform the following operations:

(1) Rotate TEST SEQUENCE switch counter-clockwise to SYS NOT RESET position. SYS NOT RESET lamp (amber) will illuminate.

(2) Press and release MANUAL SYSTEM RESET switch. SYS NOT RESET lamp (amber) will extinguish.

NOTE

When the MANUAL SYSTEM RESET switch is pressed and released, and 28 volts DC power has been applied, the sequencer switch inside the dispenser assembly resets, making an audible sound as it rotates. If the sequencer switch has been previously reset or if the switch is in position 12 or 24, there will be no such sound.

(3) Rotate TEST SEQUENCE switch counter-clockwise to STRAY VOLT position. STRAY VOLTAGE lamp (red) should not illuminate.

(4) Rotate TEST SEQUENCE switch counter-clockwise to START/HOME position.

NOTE

When the TEST SEQUENCE switch is turned to the OFF position, the DISPENSER COMPLETE lamp will extinguish, the STRAY VOLTAGE lamp will illuminate and then will extinguish when the OFF position is reached.

24. Reinstall safety pins.

25. Disconnect test set power cable.

26. Remove M-91 test set from dispenser assembly and restore in carrying case along with the power cable and hexagonal wrench.

27. On DCP, set ARM-SAFE switch to SAFE position.

28. On DCP, reset CHAFF counter to 30.

29. Disconnect aircraft power by pulling the CHAFF FLARE DISP circuit breaker located on the copilot's circuit breaker panel (fig. 2-17).

30. Proceed immediately to ammunition loading procedures.

4-4. Ammunition. RU-21A

a. Ammunition Loading Procedure.

WARNING

Only one shipping container is to be opened at a time. If a shipping container has been opened and only partially emptied, the remaining contents will be secured in the container with an appropriate type of packaging material or filler to adequately prevent jostling. All munitions in storage must be in their original shipping containers.

1. Place payload module assembly on work bench in approved safe area so that the retaining plate is facing up.

2. Remove retaining plate by unscrewing two retaining bolts.

3. Insert one flare (or chaff) at a time into each chamber of payload module.

4. Remove plastic dust cap from each chaff or flare.

CAUTION

Prior to insertion of an impulse cartridge, be sure there is preformed packing in the flare cartridge. (There will be no preformed packing in chaff cartridges.) Reinstall any preformed packing that is inadvertently removed with dustcap. The loading of impulse cartridges into a flare or chaff shall be accomplished one at a time.

5. Insert one impulse cartridge into each flare (or chaff).

6. Install retainer plate assembly by screwing to two retainer bolts into payload module.

WARNING

The system must have been tested to assure that there is no stray voltage and all aircraft power must be removed from the system prior to unloading the payload module.

7. On the dispenser control panel, assure ARM-SAFE switch is in SAFE position.

8. On the electronic module and right wing assure safety pins and flag assemblies are installed.

9. Slide payload module assembly into dispenser assembly and secure two stud bolts, hand tight, using 5/32 inch hexagonal wrench.

b. Ammunition Unloading Procedure.

WARNING

All aircraft power to the dispenser system must be turned off prior to removal of payload module from dispenser assembly. Safety pin flag shall be installed in the electronic module prior to landing and the safety pin flag shall be installed in the wing-mounted safety switch immediately after landing.

1. On dispenser control panel, assure ARM-SAFE switch is in SAFE position.

2. Assure safety pin and flag are inserted into electronic module and in the wing mounted safety switch.

WARNING

If there is an indication that a misfire occurred, notify EOD personnel for disposition and disposal.

3. Remove module from dispenser assembly by unscrewing two stud bolts with a 5/32 inch hexagonal wrench and sliding out of dispenser assembly.

4. Remove retaining plate from payload module by unscrewing two retaining bolts.

5. Remove expended and unexpended impulse cartridges and flares (or chaff) from payload module.

6. Repack unexpended items in original containers and return to stores.

NOTE

It is not unusual for the case of a chaff cartridge to crack when fired. It does not effect performance of the item and should not be reported as a malfunction.

4-5. Radar Signal Detecting Set (AN/APR-39(V)1) RU-21A

The radar signal detecting set (fig. 4-3) indicates the relative position of search radar stations. Audio warning signals are applied to the pilot's and copilot's headsets. The radar signal detecting set is fed through the 50-ampere LH MAIN AVIONICS and RH MAIN AVIONICS circuit breakers on the copilot's circuit breaker panel and protected by the 7.5-ampere APR-39 circuit breaker on the copilot's circuit breaker panel. The associated antennas are shown in figure 2-1. For operating instructions, refer to TM 11-5841-283-20.

a. Radar Signal Detecting Set Control Panel Functions (AN/APR-39(V)1).

CONTROL	FUNCTION
PWR switch	Turns set on or off.
SELF TEST switch	Initiates self test.
DSCRM switch	Turns discriminate function on or off.
AUDIO control	Adjusts audio level.

b. Radar Signal Detecting Set Indicator Functions (fig. 4-4).

CONTROL	FUNCTION
MA indicator	Illuminates to indicate the presence of an MA threat.
BRIL control	Adjusts brilliance.
DAY-NIGHT control	Rotate to adjust intensity of display.

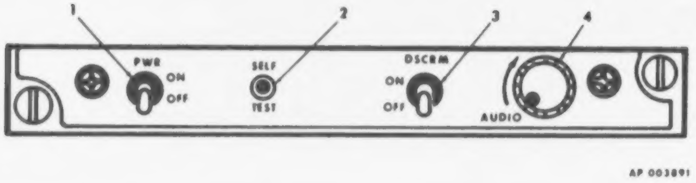
4-6. Radar Signal Detecting Set (AN/APR-39(V)2). RU-21A

The radar signal detecting set indicates the relative position of search radar stations. Differentiation is also made between various types of search radar and tracking stations. Audio warning signals are applied to the pilot's and copilot's headsets. The radar signal detecting set is fed through the 50-ampere LH MAIN AVIONICS and RH MAIN AVIONICS circuit breakers on the copilot's circuit breaker panel and protected by the 7.5-ampere APR-39 circuit breaker on the copilot's circuit breaker panel. The associated antennas are shown in fig. 2-1. For operating instructions refer to (C) TM 11-5841-283-20-1.

4-7. Radar Warning Receiver (AN/APR-44( )(V)3). RU-21A

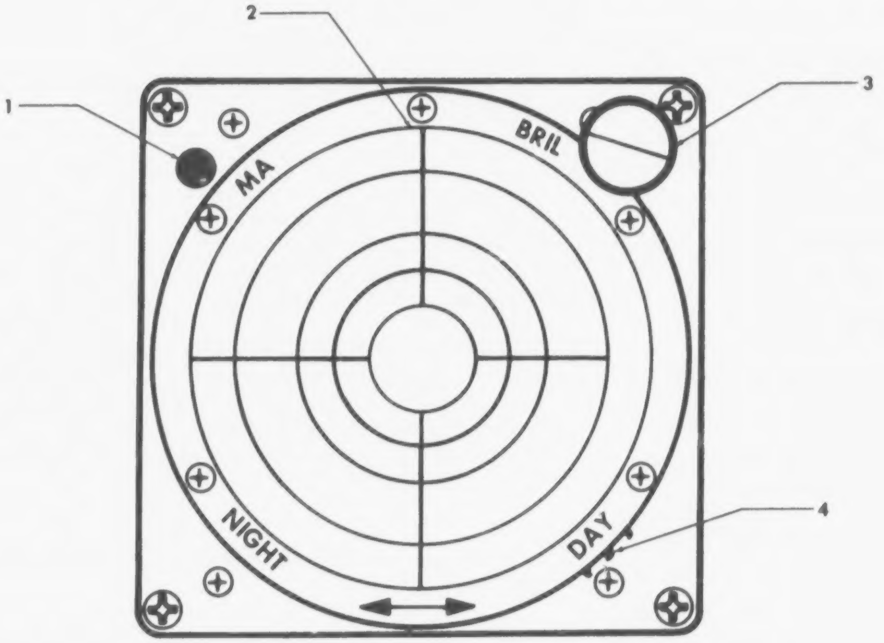
The radar warning receiver (fig. 4-5) indicates the presence of certain types of search radar signals. The radar warning receiver is fed through the 50-ampere LH MAIN AVIONICS and RH MAIN AVIONICS circuit breakers on the copilot's circuit breaker panel and protected by the 5-ampere circuit breaker on the copilot's circuit breaker panel. For operating instructions, refer to TM 11-5841-291-12.

CONTROL	FUNCTION
Radar warning indicator	Illuminates to indicate the presence of an AI or SAM threat.
VOLUME control	Adjusts volume.
POWER switch	Turns set on or off.



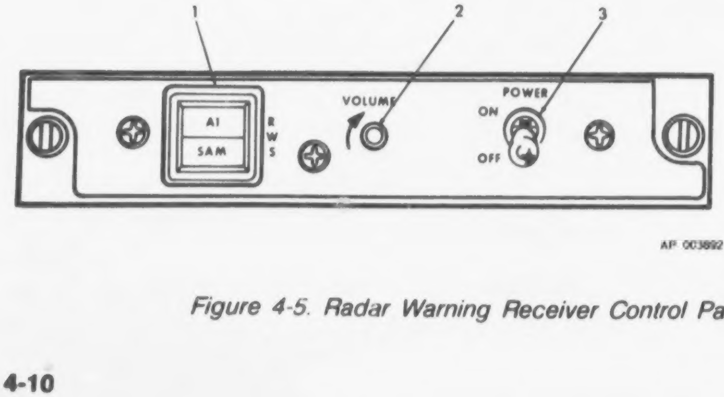
1. PWR switch
2. SELF TEST switch
3. DSCRM switch
4. AUDIO control

Figure 4-3. Radar Signal Detecting Set (AN/APR-39(V)1)



1. MA indicator
2. Display
3. BRIL control
4. DAY-NIGHT control

Figure 4-4. Radar Signal Detecting Set Indicator



1. Radar warning indicator
2. VOLUME control
3. POWER switch

Figure 4-5. Radar Warning Receiver Control Panel (AN/APR-44( ) (V3)

CHAPTER 5

OPERATING LIMITS AND RESTRICTIONS

Section I. GENERAL

5-1. Purpose.

This chapter identifies or refers to all important operating limits and restrictions that shall be observed during ground and flight operations.

5-2. General.

The operating limitations set forth in this chapter are the direct result of design analysis, tests, and operating experiences. Compliance with these limits will allow the pilot to safely perform the assigned missions and to derive maximum utility from the aircraft.

5-3. Exceeding Operational Limits.

Anytime an operational limit is exceeded an appropriate entry shall be made on DA Form 2408-13. Entry shall state what limit or limits were exceeded, range, time beyond limits, and any additional data that would aid maintenance personnel in the maintenance action that may be required.

5-4. Minimum Crew Requirements.

The minimum crew for a normal mission consists of two pilots and two mission operators. The minimum crew for all other missions consists of one pilot. Additional crewmembers as required will be added at the discretion of the commander, in accordance with pertinent Department of the Army regulations.

Section II. SYSTEM LIMITS

5-5. Instrument Markings.

Several instruments display operating limitations (fig. 5-1). The operating limitations are color coded on the instrument faces. Color coding of each instrument is explained in the illustration. The instrument illustration also denotes, in bold type, the fuel grade upon which limits are based.

5-6. Instrument Marking Color Codes.

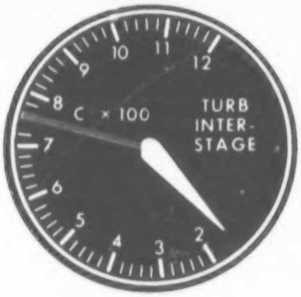
Operating limitations and ranges are illustrated by the colored markings which appear on the dial faces of engine, flight, and utility system instruments. RED markings on the dial faces of these instruments indicate the limit above or below which continued operation is likely to cause damage or shorten life. The GREEN markings on instruments indicate the safe or normal range of operation. The YELLOW markings on instruments indicate the range when special attention should be given to the operation covered by the instrument. Operation is permissible in the yellow range, but should be avoided. WHITE markings on the instruments indicate flap operating range.

5-7. Instrument Glass Alignment Marks.

Limitation markings consist of strips of semi-transparent color tape which adhere to the glass outside of an indicator dial. Each tape strip shall align to increment marks on the dial face so correct operating limits are portrayed. The pilot should occasionally verify alignment of the glass to the dial face. For this purpose, all engine instruments (except fuel flow meters) have short, vertical white alignment marks extending from the bottom part of the dial glass onto the fixed base of the indicator. These slippage marks appear as a single vertical line when limitation markings on the glass properly align with reading increments on the dial face. However, the slippage marks appear as separate radial lines when a dial glass has rotated.

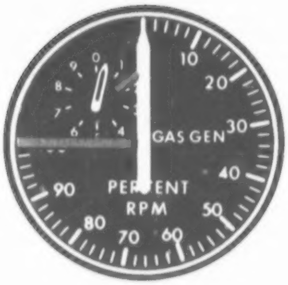
5-8. Propeller Limitations.

Propeller limitations consist of RPM limits and situation limits for the use of reverse pitch. The



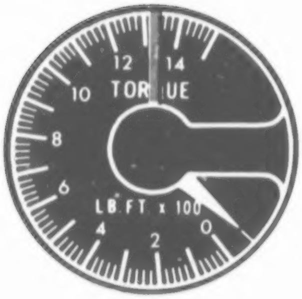
INTERSTAGE TURBINE TEMPERATURE

🟥 750 C MAXIMUM



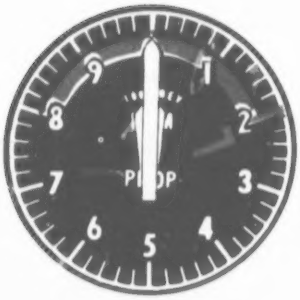
TURBINE TACHOMETER (N1 SPEED)

🟥 101.5% MAXIMUM



TORQUE

🟥 1315 FT LB MAXIMUM



PROPELLER TACHOMETER

🟩 1800-2200 RPM NORMAL OPERATING RANGE

🟥 2200 RPM MAXIMUM

R 🟥
G 🟩

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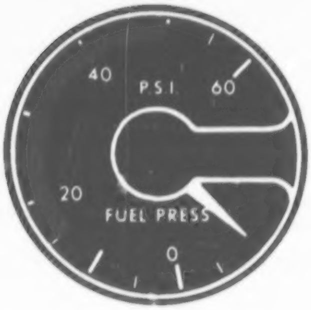
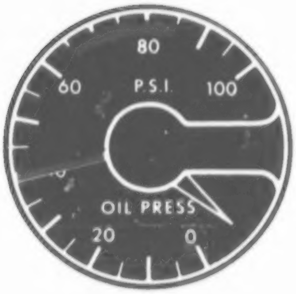
Figure 5-1. Instrument Markings (sheet 1 of 3)

FUEL GRADE JP-4



FUEL PRESSURE

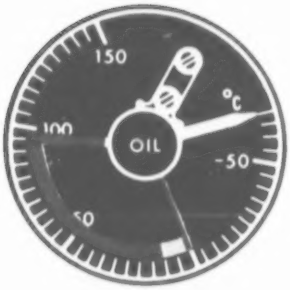
■ 15-50 PSI NORMAL OPERATING RANGE



OIL PRESSURE

■ 40 PSI MINIMUM

■ 65-85 PSI NORMAL OPERATING RANGE



OIL TEMPERATURE

■ 0 C MINIMUM

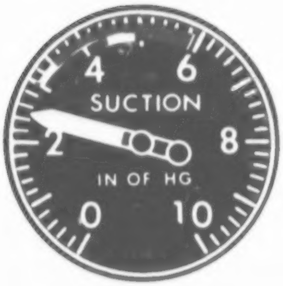
99 C MAXIMUM USING ENGINE OIL SPEC MIL-L-23699

* 85 C MAXIMUM USING ENGINE OIL SPEC MIL-L-7808

□ 0-10 C CAUTIONARY

■ 10-99 C NORMAL OPERATING RANGE USING ENGINE OIL SPEC MIL-L-23699

* 10-85 C NORMAL OPERATING RANGE USING ENGINE OIL SPEC MIL-L-7808



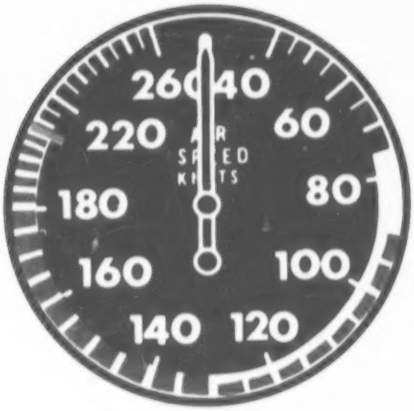
SUCTION

■ 4.3-5.9 IN HG NORMAL OPERATING RANGE, SL -15,000 FT 3.0-4.3 IN HG NORMAL OPERATING RANGE, 15,000-30,000 FT

* FOR OPERATION BELOW -40 F (-40 C)

AP 001616.2

Figure 5-1. Instrument Markings (sheet 2 of 3)

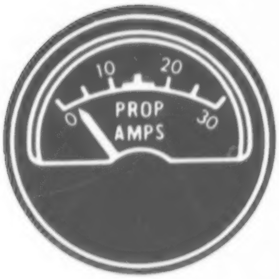


AIRSPEED INDICATOR

☐ 75-130 KNOTS (CAS) NORMAL OPERATING RANGE WITH FULL FLAPS

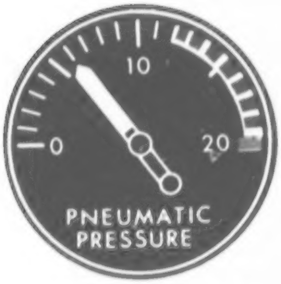
■ 92-208 KNOTS (CAS) NORMAL OPERATING RANGE

▨ 208 KNOTS (CAS) MAXIMUM



PROPELLER DEICER AMMETER

■ 14-18 AMPERES NORMAL OPERATION



PNEUMATIC PRESSURE

■ 12-20 PSI NORMAL OPERATING RANGE

▨ 20 PSI MAXIMUM

R ▨
G ■

AP 001616.3

Figure 5-1. Instrument Markings (sheet 3 of 3)

normal propeller operating range (green arc) extends from 1800 to 2200 RPM, with a red line at 2200 RPM. However, the actual governor controlled limits are 1750 to 2332 RPM. The lower limit of 1725 to 1775 RPM is controlled by the primary governor. The upper limit of 2332 RPM is maintained by the power turbine governor (should the primary and overspeed governors fail). During reverse pitch operation, the power turbine governor prevents propeller speed from exceeding 2040 RPM. Refer to Chapter 2 for propeller governor details.

5-9. Starter Limitations.

a. For RU-21A aircraft, do not exceed starter limitations of 40 seconds on, and 60 seconds off for two starting operations; then 40 seconds on, 30 minutes off.

b. For RU-21D aircraft, observe starter limits of 2 minutes on, 3 minutes off, 2 minutes on, 30 minutes off.

Section III. POWER LIMITS

5-10. Engine Limitations.

Operation of the T74-CP-700 engines is monitored by instruments with the operating limits marked on the face of the dial. Table 5-1 shows all operating conditions and limits for the engine.

a. Engine operation using only the engine-driven fuel pump, without boost pump fuel pressure, is limited to 10 cumulative hours. All time in this category shall be entered on DA Form 2408-13 for the attention of maintenance personnel.

b. Use of aviation gasoline is time-limited to 150 hours of operation during any Time-Between-Overhaul (TBO) period. It may be used in any quantity with primary or alternate fuel.

NOTE

Aviation gasoline (AVGAS) contains a form of lead which has an accumulative adverse effect on gas turbine engines. The lowest octane AVGAS available (less lead content) should be used. If any AVGAS is used, the total operating time shall be entered on DA Form 2408-13.

5-11. Overtemperature and Overspeed Limitations.

a. Whenever the limiting temperatures listed in the Engine Operating Limitations chart are exceeded and cannot be controlled by retarding the power levers the engine shall be shut down or a landing shall be made as soon as possible. It should be noted that maximum observed interstage turbine temperature (ITT) of 850°C is time-limited to two seconds duration when accelerating engine.

b. During engine starting the temperatures and time limits listed in the Engine Operating Limitations chart shall be observed (table 5-1). When these limits are exceeded, the incident shall be reported as an engine discrepancy on DA Form 2408-13. It is particularly important to record the amount and duration of overtemperature.

c. Whenever the prescribed engine overspeed limit or engine RPM operating limit is exceeded the incident must be reported as an engine discrepancy on DA Form 2408-13. It is particularly important to record the maximum percent of RPM registered by the tachometer, and the duration of overspeed.

d. Ground operation of inverters, with aircraft engines shut down, is limited to 30 minutes unless the inverter access/cooling doors on the upper wing are removed.

5-12. Power Definitions For Engine Operation.

The following definitions describe the engine power ratings listed in the Engine Operating Limitations Chart, table 5-1.

a. *Takeoff Power.* The maximum power available from an engine for takeoff, limited to periods of five minutes duration.

b. *Maximum Power.* The maximum power available from an engine for use during an emergency operation.

c. *Normal Rated Climb Power.* The maximum power available from an engine for continuous normal climb operations.

d. *Normal Rated Power.* The maximum power available from an engine for continuous operation in cruise (with lower ITT limit than normal rated climb power).

Table 5-1. Engine Operating Limitations

POWER RATING	OPERATING LIMITS							
	MAX TIME	★ TORQUE FT LB	★MAX OBSERVED ITT	① N1%	● N2 RPM (PROP)	OIL PRESS PSIG ②	OIL TEMP °C ③	OIL TEMP °C ④
TAKEOFF ⑤	5 MINUTES	1315	750	101.5	2200	65-85	10-99	10-85
MAXIMUM	CONTINUOUS	1315	750	101.5	2200	65-85	10-99	10-85
NORMAL RATED CLIMB	CONTINUOUS	1315✱	725	---	2000	65-85	0-99	0-85
NORMAL RATED	CONTINUOUS	1315✱	705	---	2200	65-85	0-99	0-85
HIGH IDLE (73% N1)	CONTINUOUS	---	---	---	---	---	0-99	0-85
LOW IDLE (54% N1)	CONTINUOUS	---	685 ⑥	---	---	40 (MIN)	-40-99	-40-85
STARTING	---	---	1090 (2 SEC)	---	---	---	-40 (MIN)	-40 (MIN)
ACCELERATION ⑦	2 SECONDS	1500	850	102.6	---	---	0-99	0-85
MAX REVERSE	1 MINUTE	---	750	88	---	65-85	0-99	0-85
PROP FEATHER	CONTINUOUS	525	---	---	---	---	---	---
	2 SECONDS	1500	---	---	---	---	---	---

GENERATOR LOAD	MINIMUM ENGINE RPM
0 to .5 Load	50%
.5 to .75 Load	57%
.75 to .90 Load	59%
.90 to 1.0 Load	63%

★ Each column is a separate limitation. The stated limits do not necessarily occur simultaneously.

● The limit values within the N2 RPM (PROP) column are not propeller limitations. These values specify propeller RPMs which correspond to stress limits of the engine power section.

✱ This is an engine gearbox torque limit which shall not be exceeded under steady state or continuous engine operation.

① For every 10°C below 30°C ambient temperature, reduce maximum allowable N1 by 2.2%.

② Oil pressure below 65 PSIG is undesirable at power settings above 75% N1. Flight may be completed at a reduced power setting, but the cause of low oil pressure should be corrected prior to next flight. Oil pressure below 40 PSIG requires engine shutdown.

③ 99°C maximum when using engine oil spec MIL-L-23699.

④ 85°C maximum when using engine oil spec MIL-L-7808.

⑤ This power rating is intended for emergency use at the discretion of the pilot.

⑥ High ITT may be decreased by reducing accessory load and/or increasing N1 speed.

⑦ High generator loads at low N1 speeds may cause the ITT acceleration temperature limit to be exceeded. Observe the above generator limits.

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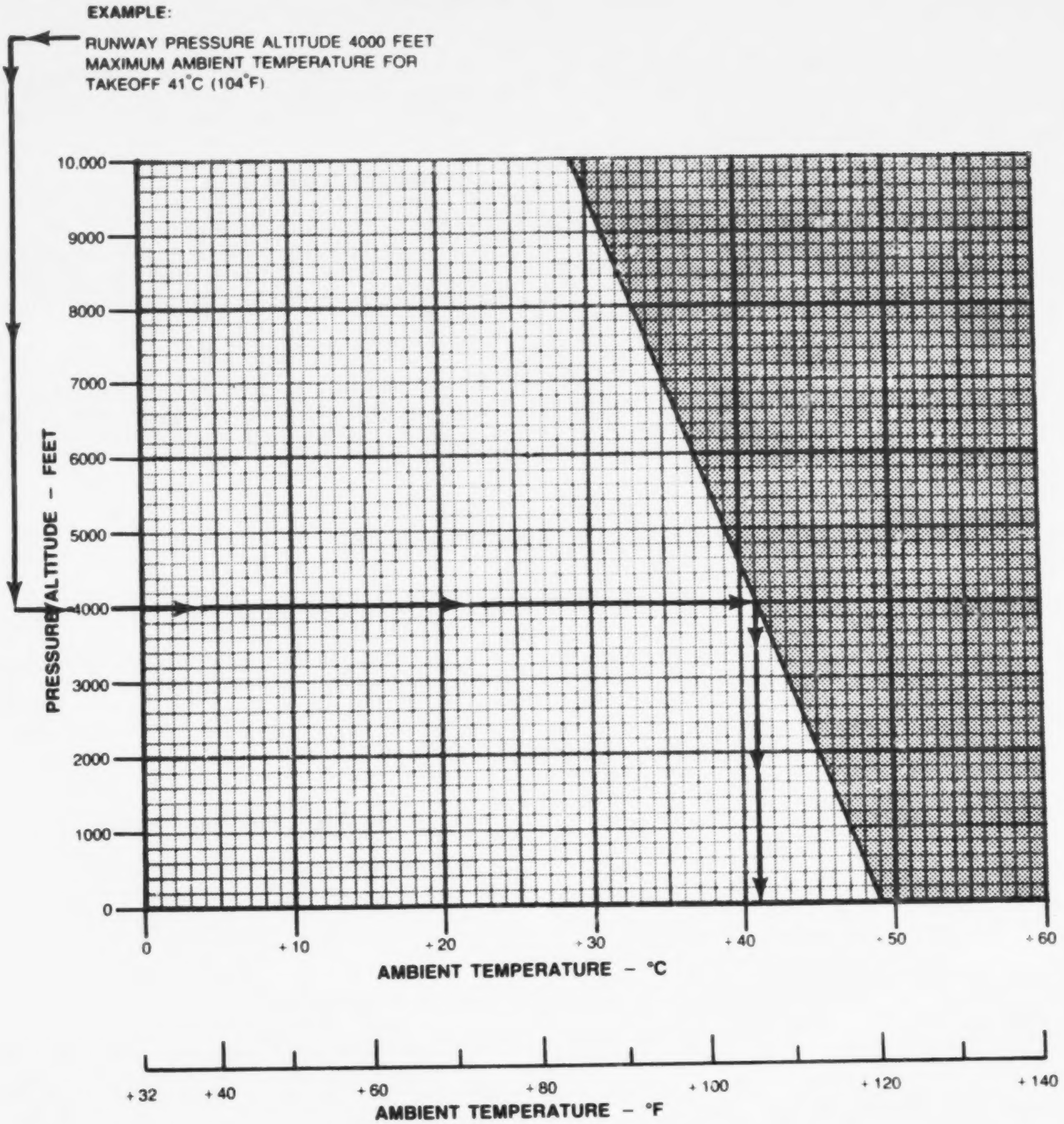

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Figure 5-2. Takeoff Temperature Limitations

5-13. Ambient Temperature Takeoff Limitation.

A limitation based on pressure altitude and ambient temperature prohibits aircraft takeoff under certain high ambient temperature conditions. The Takeoff Temperature Limitations Chart determines this limitation (fig. 5-2).

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Section IV. LOADING LIMITS

5-14. Center-of-Gravity Limitations.

CAUTION

When oxygen bottles are not installed in the cabin, check aircraft loading to avoid exceeding forward CG limit. Flight operations involving forward loadings while the oxygen bottles are removed are critical, i.e., pilot and copilot only or forward loaded cargo and/or passengers.

NOTE

The RU-21A and RU-21D are special mission-equipped aircraft and no cargo or passengers will be loaded.

Center of gravity limits and instructions for computation of center of gravity are contained in Chapter 6.

5-15. Weight Limitations.

a. For RU-21A, the maximum designed gross weight is 10,200 pounds for takeoff and 9700 pounds for landing. Maximum ramp weight is 10,255 pounds.

b. For RU-21D, the maximum designed gross weight is 9650 pounds for takeoff and 9168 pounds for landing. Maximum ramp weight is 9705 pounds.

Section V. AIRSPEED LIMITS

5-16. Airspeed Limitations.

Airspeed indicator readings contained in procedures, text, and illustrations throughout the Operator's Manual are given as indicated airspeed (IAS). Airspeed indicator markings (fig. 5-1) and placarded airspeeds, located on the cockpit overhead control panel (fig. 2-35), are calibrated airspeed (CAS). Refer to the Airspeed Calibration Chart in Chapter 7.

5-17. Maximum Allowable Airspeed (V_{mo}).

The maximum allowable airspeed is 208 KIAS (V_{mo}). Operation above this speed may cause structural damage. The Flight Envelope Chart (fig. 5-3 or 5-4) may be used to determine limiting airspeeds at maximum gross weight under various load factors.

5-18. Turbulence Penetration Speed.

The maximum safe penetration speed in severe turbulence is 168 KIAS.

NOTE

Altitude variations do not affect the limits shown in the Flight Envelope Chart (fig. 5-3 and fig. 5-4).

5-19. Landing Gear Extension Speed.

The airspeed limit for extending the landing gear and for flight with the landing gear extended is 154 KIAS. Above this speed, air loads may damage the landing gear doors or their operating mechanisms.

5-20. Landing Gear Retraction Speed.

The airspeed limit for retracting the landing gear is 130 KIAS. If the landing gear is retracted above this speed, air loads may damage the landing gear operating mechanism.

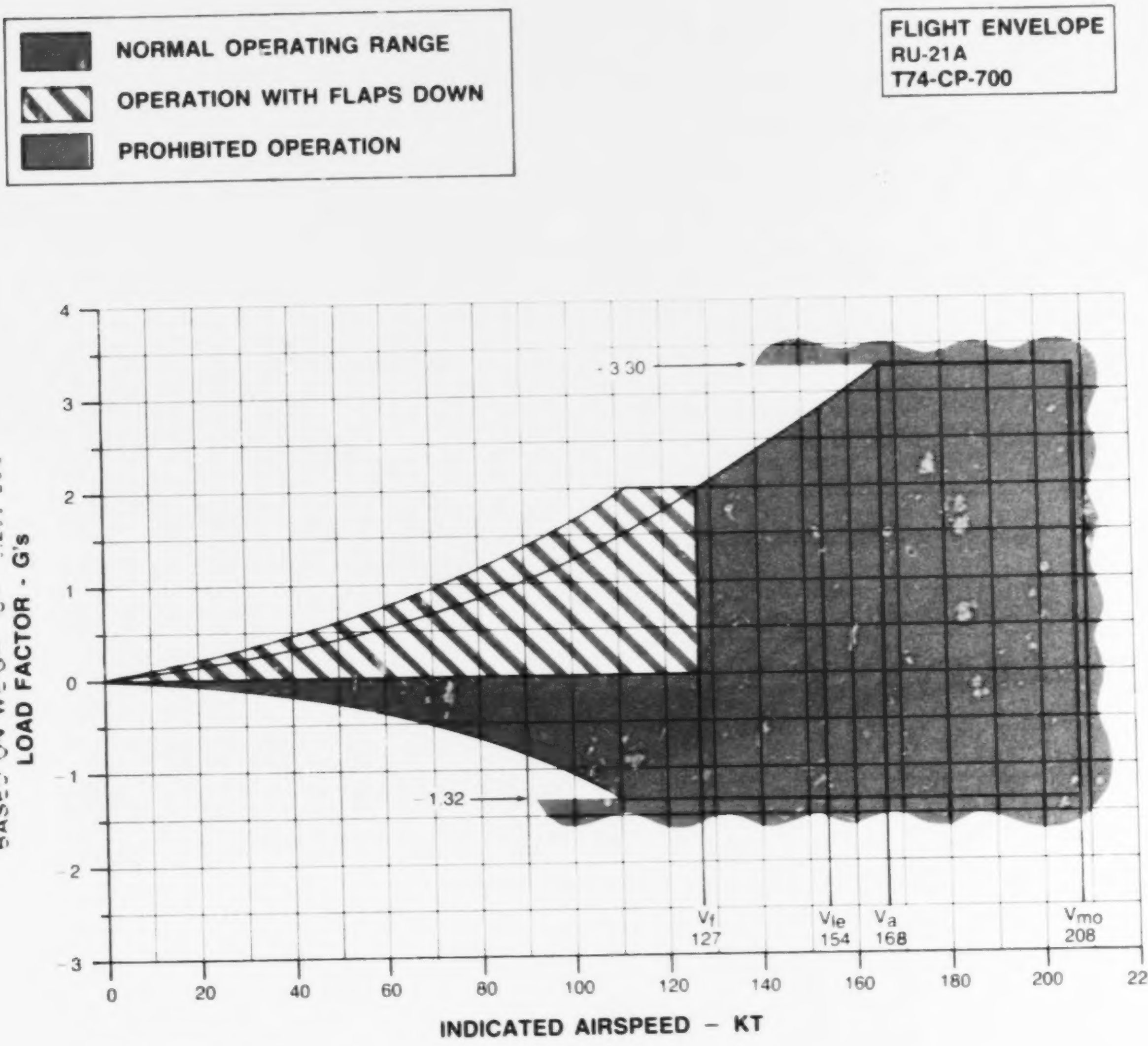
5-21. Wing Flap Extension Speeds.

The airspeed limit for lowering the flaps to the approach position (35%) is 173 KIAS. The airspeed limit for extending the flaps from the approach position to the full down, or any intermediate position is 130 KIAS. If indicated airspeeds exceed these limitations, the flaps or their operating mechanisms may be damaged.

5-22. Cockpit Vent/Storm Window Speed.

No airspeed limitations are imposed on cockpit vent/storm windows.

FLIGHT ENVELOPE



V_f - DESIGN FLAP SPEED

V_a - DESIGN MANUVERING SPEED

V_{le} - DESIGN GEAR EXTENDED SPEED

V_{mo} - MAX OPERATING LIMIT SPEED

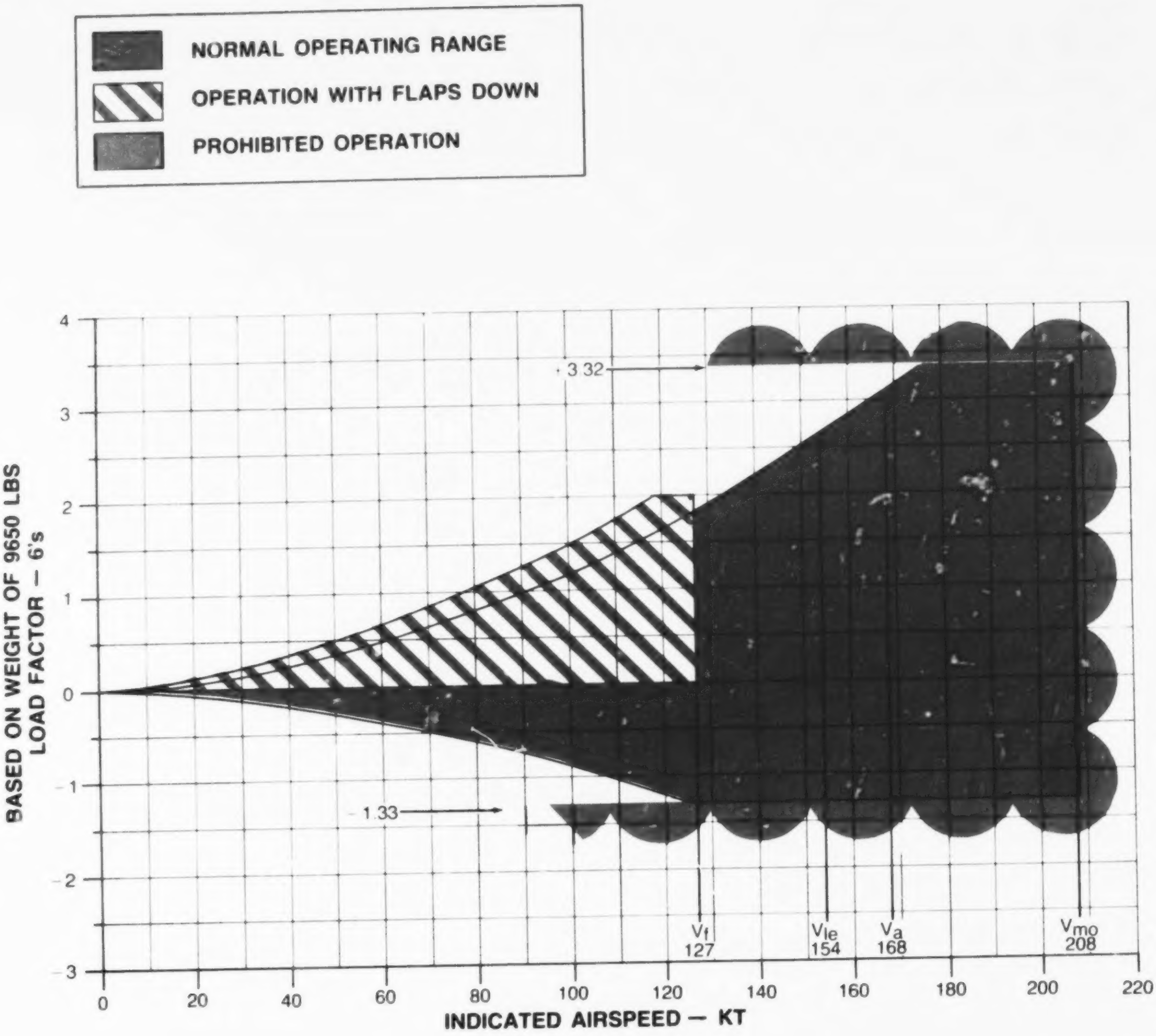
NOTE
ALTITUDE VARIATIONS DO NOT AFFECT THE LIMITS SHOWN

AV 111467

Figure 5-3. Flight Envelope Chart **RU-21A**

FLIGHT ENVELOPE

FLIGHT ENVELOPE
RU-21D
T74-CP-700



V_f - DESIGN FLAP SPEED

V_a - DESIGN MANUVERING SPEED

V_{le} - DESIGN GEAR EXTENDED SPEED

V_{mo} - MAX OPERATING LIMIT SPEED

NOTE
BELOW 30,000 FEET, ALTITUDE VARIATIONS DO NOT AFFECT THE LIMITS SHOWN

AP001609

Figure 5-4. Flight Envelope Chart **RU-21D**

5-23. Minimum Single-Engine Control Airspeed (V_{mc}).

Refer to Chapter 7, Section X for Minimum Single-Engine Control Airspeeds.

5-24. Maximum Design Maneuvering Speed (V_a).

The maximum design maneuvering speed is 168 KIAS.

Section VI. MANEUVERING LIMITS

5-25. Maneuvers.

WARNING

Operation beyond the structural capabilities of the aircraft will result in complete structural failure of one or more airframe components.

a. The following maneuvers are prohibited.

(1) Spins.

(2) Aerobatics of any kind.

(3) Abrupt maneuvers above 168 KIAS.

(4) For RU-21A aircraft any maneuver which results in a positive load factor of 3.30 G's or a negative load factor of 1.68 G's with wing flaps up or a positive load factor of 2.0 G's, or negative G's with wing flaps down (fig. 5-3).

(5) For RU-21D aircraft, any maneuver which results in a positive load factor of 3.70 G's or a negative load factor of 1.68 G's with wing flaps up or a positive load factor of 2.0 G's, or negative G's with wing flaps down (fig. 5-4).

b. The maximum design maneuvering speed is 168 KIAS. For turbulent air penetration use an airspeed of 174 KIAS (RU-21A) or 169 KIAS (RU-21D). Avoid over-action on power levers, turn off autopilot altitude hold, keep wings level, maintain attitude and avoid use of trim. Do not chase airspeed and altitude. Penetration should be at an altitude which provides adequate maneuvering margins when severe turbulence is encountered.

5-26. Bank and Pitch Limits.

a. Bank limits are 60°. On RU-21D aircraft bank limit is 4° on takeoff and landing.

b. Pitch limits are 30° above or below the horizon.

Section VII. ENVIRONMENTAL RESTRICTIONS

5-27. Altitude Limitations In Visible Moisture.

CAUTION

The flight of RU-21D aircraft into known icing conditions is prohibited, due to the lack of an anti-icing system for the dipole antennas.

5-28. Altitude Limitations.

The maximum altitude that the aircraft may be operated at is 26,150 feet (RU-21A) or 25,750 feet (RU-21D). The single engine service ceiling is 12,000 feet (RU-21A) or 9100 feet (RU-21D).

5-29. Autoignition During Night Operation.

Autoignition shall be used during night operation at or above 14,000 feet.

5-30. Flight Under IMC (Instrument Meteorological Conditions).

This aircraft is approved for operation in instrument meteorological conditions.

5-31. Wind Limitations.

CAUTION

When RU-21D aircraft is in a mission antenna configuration, maximum bank angle for crosswind landing is 4 degrees.

The maximum demonstrated crosswind for landing is 25 knots. Refer to Chapter 7 for wind limitations.

5-32. Oxygen Requirements.

One oxygen mask and an adequate supply of aviator's breathing oxygen shall be provided each crewmember in compliance with AR95-1 for planned flights above 10,000 feet.

CHAPTER 6

WEIGHT/BALANCE AND LOADING

Section I. GENERAL

6-1. Extent of Coverage.

Sufficient data has been provided so that, knowing the basic weight and moment of the aircraft, any combination of weight and balance can be computed.

6-2. Class.

For the purpose of clarity, Army RU-21A and RU-21D aircraft are in Class I. Additional directives governing weight and balance of Class I aircraft forms and records, are contained in AR 95-16 and TM 55-405-9.

6-3. Aircraft Compartment and Stations.

The RU-21A and RU-21D are special mission-equipped aircraft designed primarily with a fixed-load configuration consisting of an installation of special navigation, communication and other electronic equipment, and the mission operators. No cargo or passengers will be loaded. Normally, the RU-21A and the RU-21D require two mission operators. The following description of the mission operator's compartment gives only the aircraft structural limits of the compartment. No compartment can be loaded beyond its structural limit and remain within the aircraft gross weight limits (fig. 6-1 and 6-2). The mission operator's compartment extends from the back of the cockpit to the aft cabin wall. This area, when completely stripped, provides a 230.0 cubic foot space with maximum measurements of 155 inches long, 57.0 inches high, and 55.0 inches wide. Access is gained through the rectangular main entrance door which measures 51.5 inches high and 26.5 inches wide. The floor is designed to withstand loads of 200 pounds per square foot supported by the seat tracks. Total load, however, must be limited in conjunction with fuel loading to stay within the design gross weight limitations.

Section II. WEIGHT AND BALANCE

6-4. Purpose.

The data to be inserted on weight and balance charts and forms are applicable only to the individual aircraft, the serial number of which appears on the title page of the booklet entitled WEIGHT AND BALANCE DATA supplied by the aircraft manufacturer and on the various forms and charts which remain with the aircraft. The charts and forms referred to in this chapter may differ in nomenclature and arrangement from time to time, but the principle on which they are based will not change.

6-5. Charts and Forms.

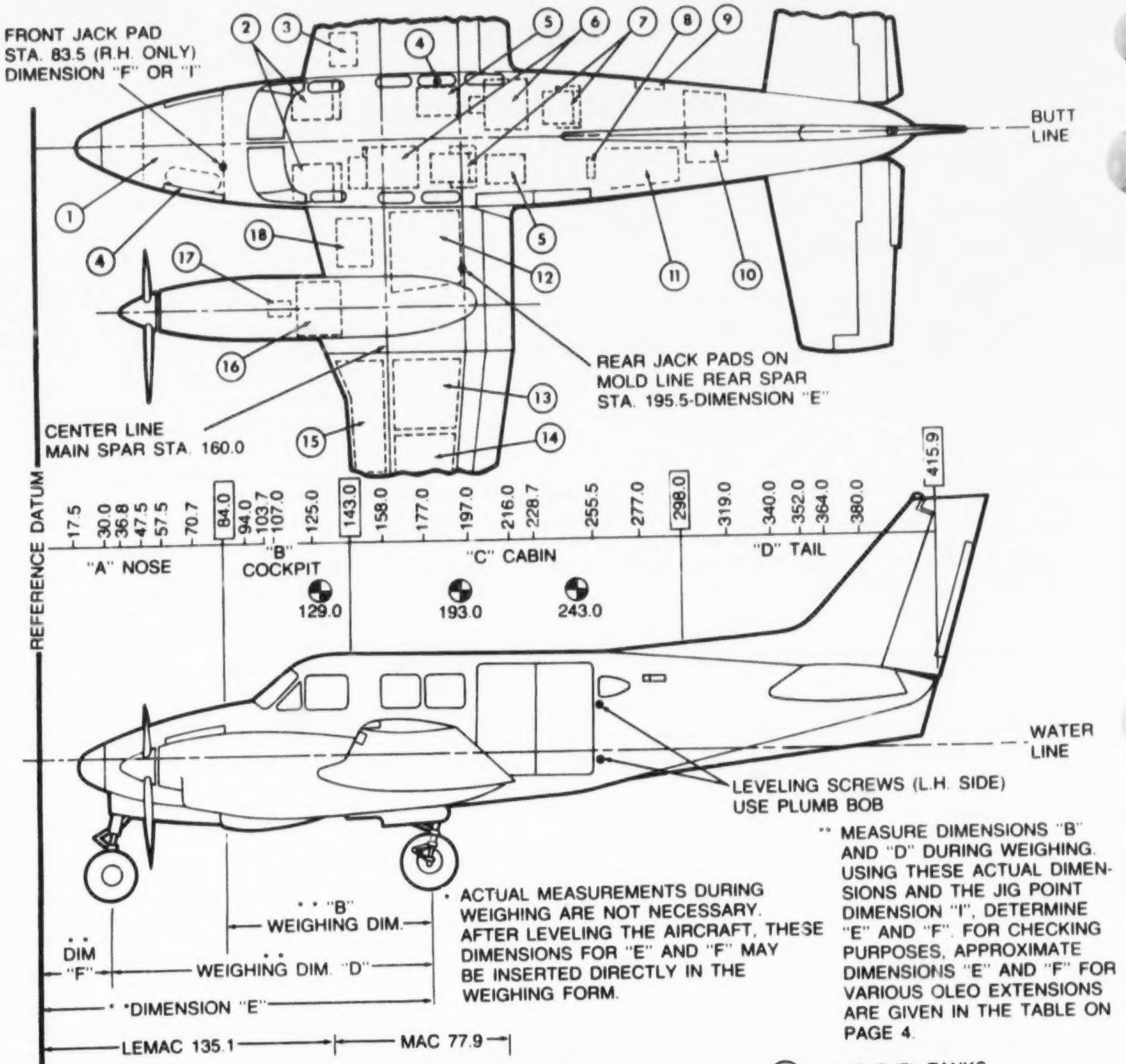
The standard system of weight and balance control require the use of several different charts and forms. Within this chapter, the following are used:

a. Chart C – Basic Weight and Balance Record, DD Form 365C (fig. 6-3 and 6-4).

b. Form F – Weight and Balance Clearance Form F, DD Form 365F (Tactical) (fig. 6-5 and 6-6).

6-6. Responsibility.

The aircraft manufacturer inserts all aircraft identifying data on the title page of the booklet entitled WEIGHT AND BALANCE DATA and on the various charts and forms. All charts, including one sample Weight and Balance Clearance Form F, if applicable, are completed at time of delivery. This record is the basic weight and balance data of the aircraft at delivery. All subsequent changes in weight and balance are compiled by the weight and balance technician.



• ACTUAL MEASUREMENTS DURING WEIGHING ARE NOT NECESSARY. AFTER LEVELING THE AIRCRAFT, THESE DIMENSIONS FOR "E" AND "F" MAY BE INSERTED DIRECTLY IN THE WEIGHING FORM.

•• MEASURE DIMENSIONS "B" AND "D" DURING WEIGHING. USING THESE ACTUAL DIMENSIONS AND THE JIG POINT DIMENSION "I", DETERMINE "E" AND "F". FOR CHECKING PURPOSES, APPROXIMATE DIMENSIONS "E" AND "F" FOR VARIOUS OLEO EXTENSIONS ARE GIVEN IN THE TABLE ON PAGE 4.

① NOSE AVIONICS COMPARTMENT
② PILOT - COPILOTS CHAIRS
③ BATTERY (R. WING ONLY)
④ OXYGEN CYLINDER (64 CU. FT.)
⑤ TYPEWRITER TABLES
⑥ MISSION EQUIPMENT CONSOLE
⑦ OPERATORS' SEATS
⑧ RIFLE RACKS
⑨ THERMOS BOTTLES (2)
⑩ AFT AVIONICS SHELF
⑪ M62102 INERTIAL MEASUREMENT UNIT AND 672600 DIGITAL COMPUTER UNIT
⑫ WING FUEL TANKS
⑬ WING FUEL TANKS
⑭ WING FUEL TANKS
⑮ WING FUEL TANKS
⑯ NACELLE FUEL TANK
⑰ STARTER-GENERATOR
⑱ AN/ARC-BX 51 (L. WING ONLY)
◐ DENOTES OCCUPANT CENTROID

AP 000927

Figure 6-1. Aircraft Compartment and Station Diagram RU-21A

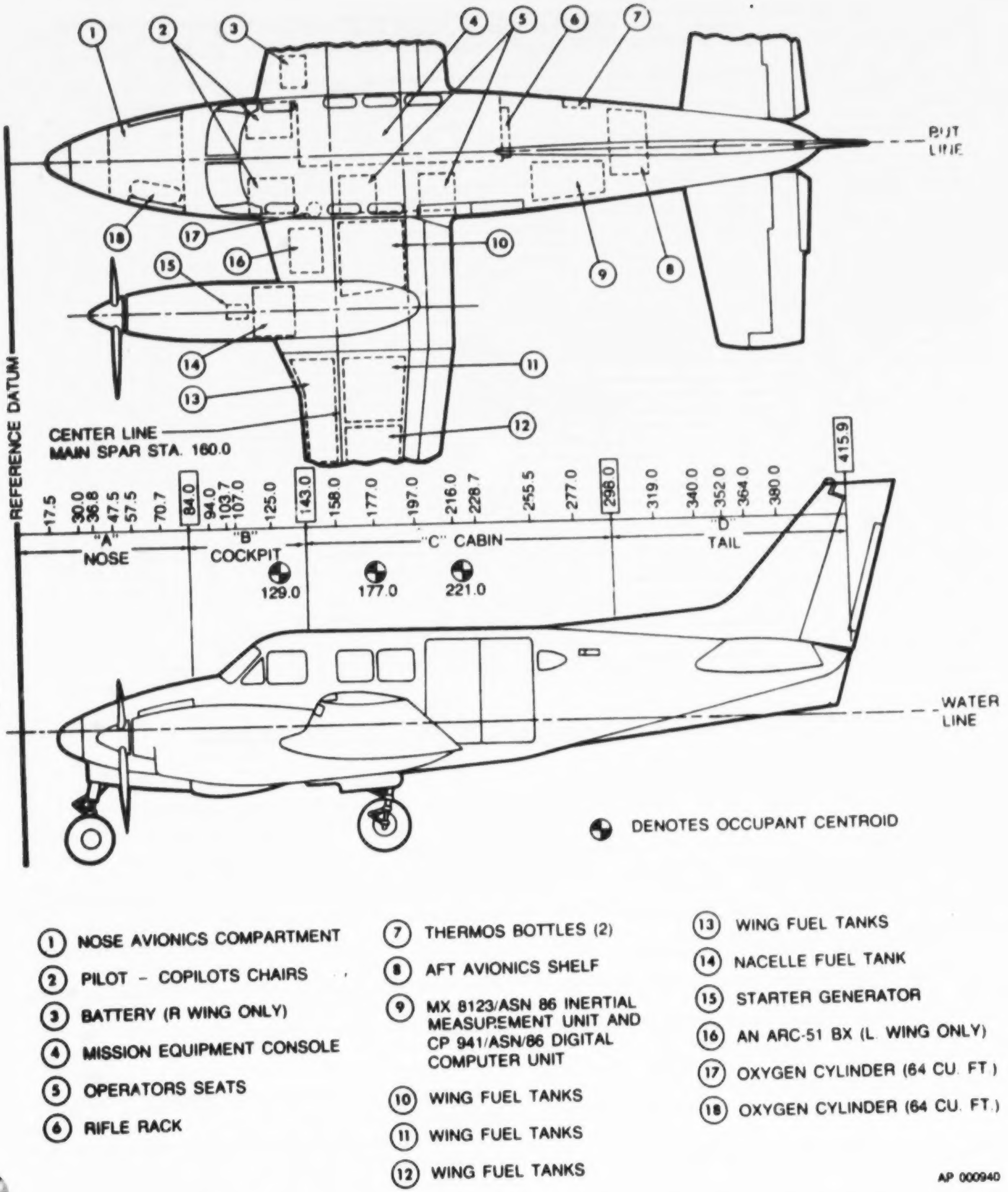


Figure 6-2. Aircraft Compartment and Station Diagram **RU-21D**

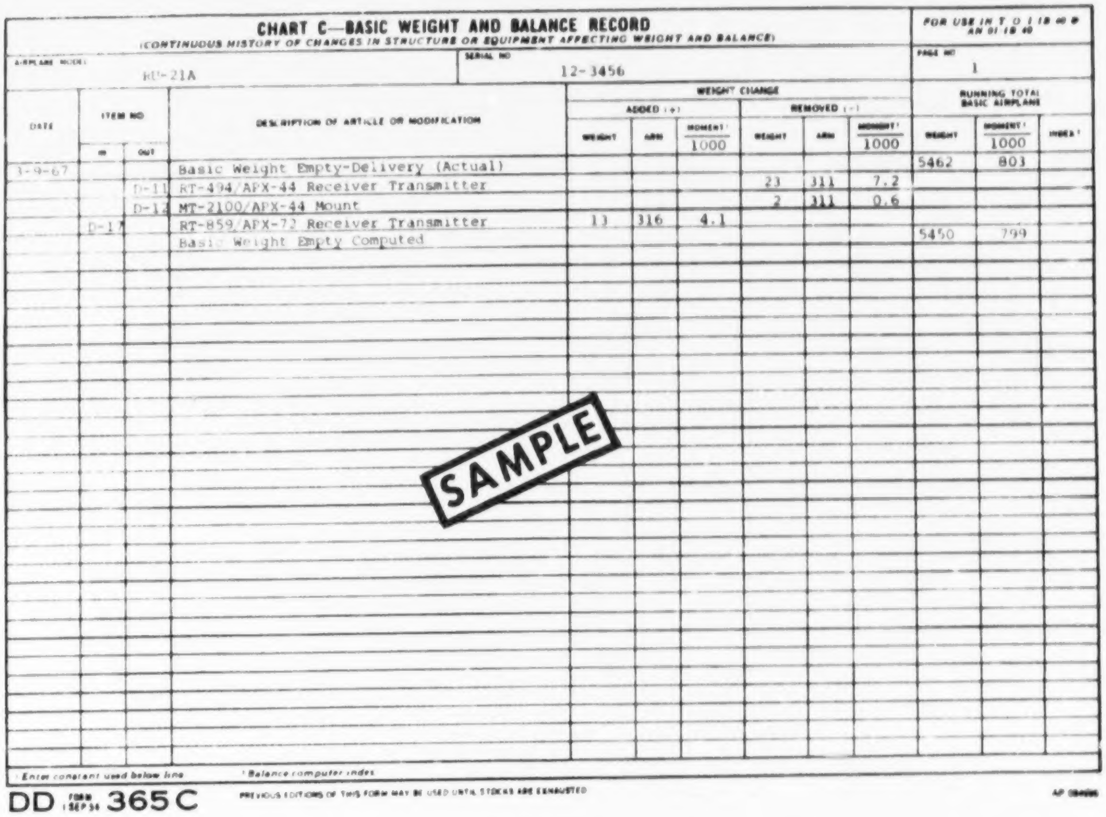


CHART C—BASIC WEIGHT AND BALANCE RECORD
(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)

FOR USE IN T.O. 1-1B-40 & AN 01-1B-40

AIRPLANE MODEL: RU-21A

SERIAL NO: 12-3456

PAGE NO: 1

DATE	ITEM NO		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE						RUNNING TOTAL BASIC AIRPLANE		
				ADDED (+)			REMOVED (−)					
	IN	OUT		WEIGHT	ARM	MOMENT¹/1000	WEIGHT	ARM	MOMENT¹/1000	WEIGHT	MOMENT¹/1000	INDEX²
3-9-67			Basic Weight Empty-Delivery (Actual)							5462	803	
		D-11	RT-494/APX-44 Receiver Transmitter				23	311	7.2			
		D-12	MT-2100/APX-44 Mount				2	311	0.6			
	D-17		RT-859/APX-72 Receiver Transmitter	13	316	4.1						
			Basic Weight Empty Computed							5450	799	

SAMPLE

¹ Enter constant used below line ² Balance computer index

DD FORM 1 SEP 54 365C PREVIOUS EDITIONS OF THIS FORM MAY BE USED UNTIL STOCKS ARE EXHAUSTED

Figure 6-3. Basic Weight and Balance Record, DD Form 365C RU-21A

6-7. Aircraft Weighings.

The aircraft must be weighed periodically as required by pertinent directives or when:

a. The pilot reports unsatisfactory flight characteristics (nose or tail heaviness).

b. Major modifications or repairs are made.

c. The basic weight data contained in the records are suspected to be in error.

6-8. Weight Definitions.

Weight definitions are as follows:

a. Basic Weight. The basic weight of an aircraft is that weight which includes all fixed operating equipment and trapped fuel and oil. It is only necessary to add variable or expendable load items for various missions. The basic weight of an aircraft varies with structural modifications and changes in fixed operating equipment. The term basic weight, when qualified with a word indicating the type of missions such as Basic Weight for Combat, Basic Weight for Ferry, etc., may be used in conjunction with directives stating what the equipment shall be for these missions. For example, extra fuel tanks and various items of equipment installed for long range ferry flight which are not normally carried on combat missions will be included in Basic Weight for Ferry but not in Basic Weight for Combat.

b. Operating Weight. The operating weight is the basic weight of the aircraft, including the crew and all equipment required for the mission, but not including fuel or payload.

c. Gross Weight. The gross weight is the total weight of an aircraft and its contents.

(1) The takeoff gross weight is the operating weight plus the variable and expendable load items which vary with the mission.

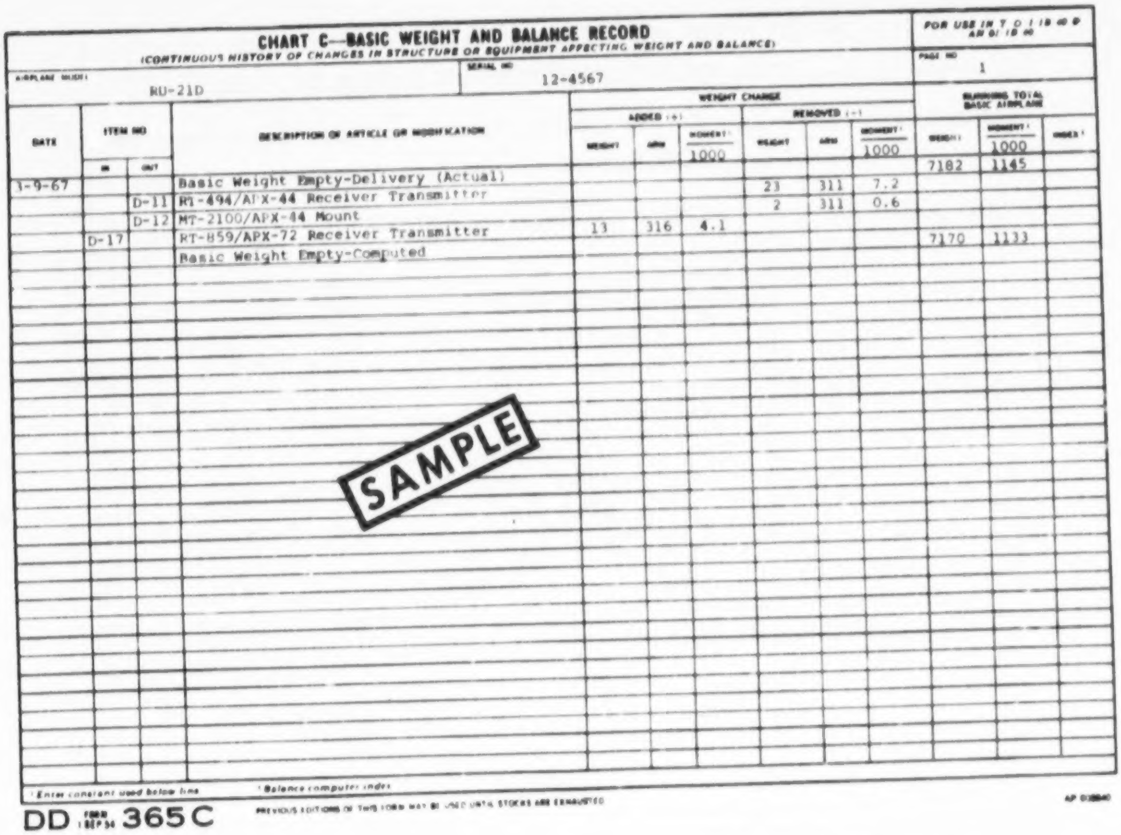


CHART C—BASIC WEIGHT AND BALANCE RECORD
(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)

FOR USE IN T.O. 1-1B-40 & AN 01-1B-40

AIRPLANE MODEL: RU-21D

SERIAL NO: 12-4567

PAGE NO: 1

DATE	ITEM NO IN	ITEM NO OUT	DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE ADDED (+) WEIGHT	ARM	MOMENT¹/1000	REMOVED (-) WEIGHT	ARM	MOMENT¹/1000	RUNNING TOTAL BASIC AIRPLANE WEIGHT	MOMENT¹/1000	INDEX²
1-9-67			Basic Weight Empty-Delivery (Actual)							7182	1145	
		D-11	RT-494/APX-44 Receiver Transmitter				23	311	7.2			
		D-12	MT-2100/APX-44 Mount				2	311	0.6			
	D-17		RT-859/APX-72 Receiver Transmitter	13	316	4.1						
			Basic Weight Empty-Computed							7170	1133	

SAMPLE

¹ Enter constant used below line ² Balance computer index

DD FORM 1 SEP 54 365C PREVIOUS EDITIONS OF THIS FORM MAY BE USED UNTIL STOCKS ARE EXHAUSTED

Figure 6-4. Basic Weight and Balance Record, DD Form 365C **RU-21D**

(2) The landing gross weight is the takeoff gross weight minus the expended load items.

6-9. Balance Definitions.

Balance definitions are as follows:

a. Reference Datum. The reference datum is an imaginary vertical plane at, or forward of, the nose of the aircraft from which all horizontal distances are measured for balance purposes. Diagrams of each aircraft show this reference datum as balance station zero.

b. Arm. Arm, for balance purposes, is the horizontal distance in inches from the reference datum to the center-of-gravity of the item. Arms may be determined from the Aircraft Compartment and Station Diagram (fig. 6-1 and 6-2).

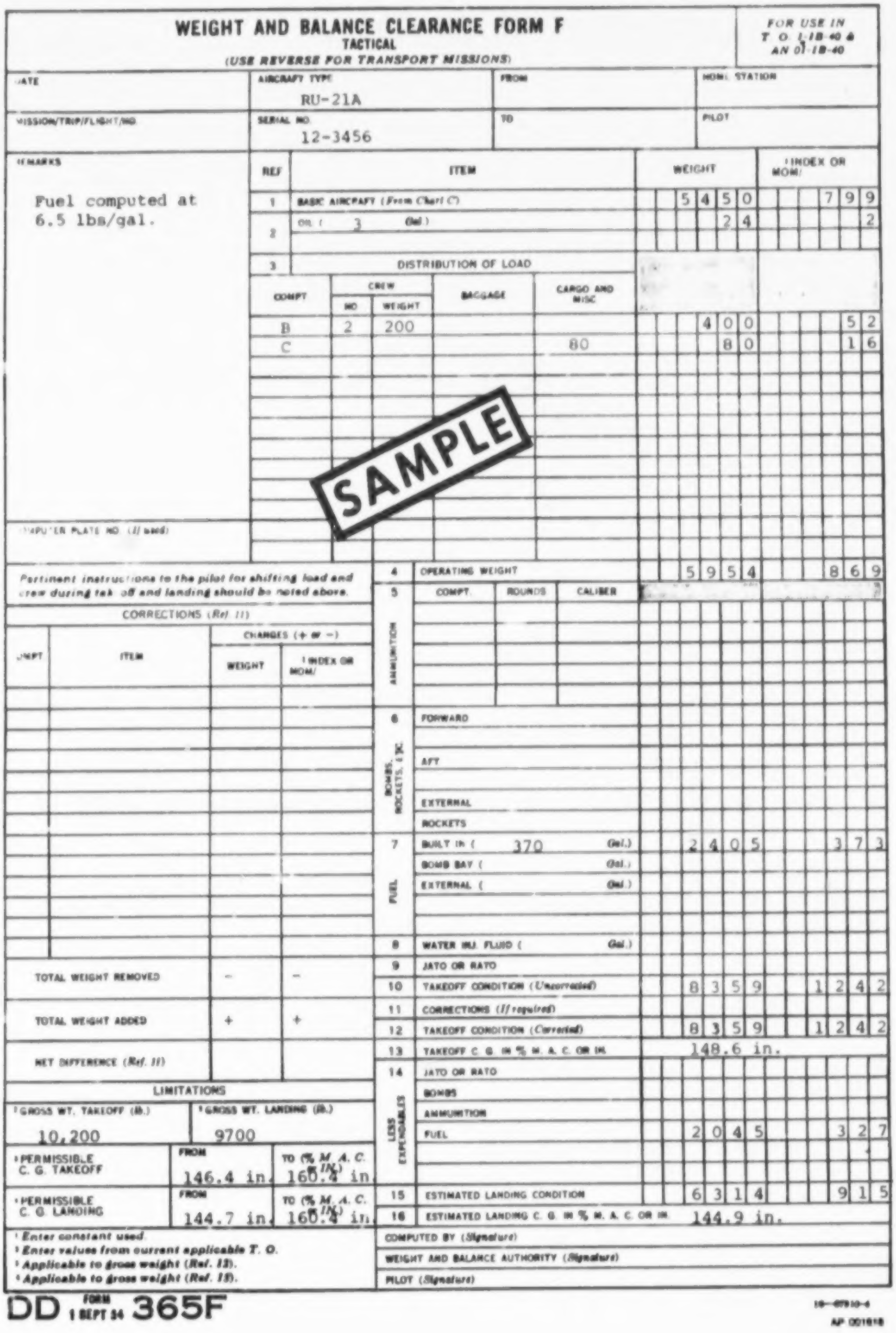
c. Moment. Moment is the weight of an item multiplied by its arm. Moment divided by a constant is generally used to simplify balance calculations by reducing the number of digits. For this aircraft, inches and moment/1000 have been used.

d. Average Arm. Average arm is the arm obtained by adding the weights and adding the moments of a number of items and dividing the total moment by the total weight.

e. Basic Moment. Basic moment is the sum of the moments of all items making up the basic weight. When using data from an actual weighing of an aircraft, the basic moment is the total moment of the basic aircraft with respect to the reference datum.

f. Center-of-Gravity (CG). Center-of-gravity is the point about which an aircraft would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the gross weight of the aircraft.

g. CG Limits. CG limits are the extremes of movement which the CG can have without making



WEIGHT AND BALANCE CLEARANCE FORM F
TACTICAL
(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN T. O. 1-1B-40 & AN 01-1B-40

DATE	AIRCRAFT TYPE RU-21A	FROM	HOME STATION
MISSION/TRIP/FLIGHT/NO	SERIAL NO. 12-3456	TO	PILOT

REMARKS

Fuel computed at
6.5 lbs/gal.

COMPUTER PLATE NO. (If used)

Pertinent instructions to the pilot for shifting load and crew during take off and landing should be noted above.

REF	ITEM	WEIGHT	[1] INDEX OR MOM/
1	BASIC AIRCRAFT (*From Chart C*)	5450	799
2	OIL (3 Gal.)	24	2
3	DISTRIBUTION OF LOAD		

COMPT	CREW NO	CREW WEIGHT	BAGGAGE	CARGO AND MISC	WEIGHT	INDEX OR MOM/
B	2	200			400	52
C				80	80	16

SAMPLE

REF	ITEM			WEIGHT	INDEX OR MOM/
4	OPERATING WEIGHT			5954	869
5	AMMUNITION	COMPT.	ROUNDS	CALIBER	
6	BOMBS, ROCKETS, ETC.	FORWARD			
		AFT			
		EXTERNAL			
		ROCKETS			
7	FUEL	BUILT IN (370 Gal.)		2405	373
		BOMB BAY (Gal.)			
		EXTERNAL (Gal.)			
8	WATER INJ. FLUID (Gal.)				
9	JATO OR RATO				
10	TAKEOFF CONDITION (*Uncorrected*)			8359	1242
11	CORRECTIONS (*If required*)				
12	TAKEOFF CONDITION (*Corrected*)			8359	1242
13	TAKEOFF C. G. IN % M. A. C. OR IN.			148.6 in.	
14	LESS EXPENDABLES	JATO OR RATO			
		BOMBS			
		AMMUNITION			
		FUEL		2045	327
15	ESTIMATED LANDING CONDITION			6314	915
16	ESTIMATED LANDING C. G. IN % M. A. C. OR IN.			144.9 in.	

COMPUTED BY (*Signature*)

WEIGHT AND BALANCE AUTHORITY (*Signature*)

PILOT (*Signature*)

CORRECTIONS (*Ref. 11*)

COMPT	ITEM	CHANGES (+ or −) WEIGHT	CHANGES (+ or −) [1] INDEX OR MOM/
	TOTAL WEIGHT REMOVED	−	−
	TOTAL WEIGHT ADDED	+	+
	NET DIFFERENCE (*Ref. 11*)		

LIMITATIONS

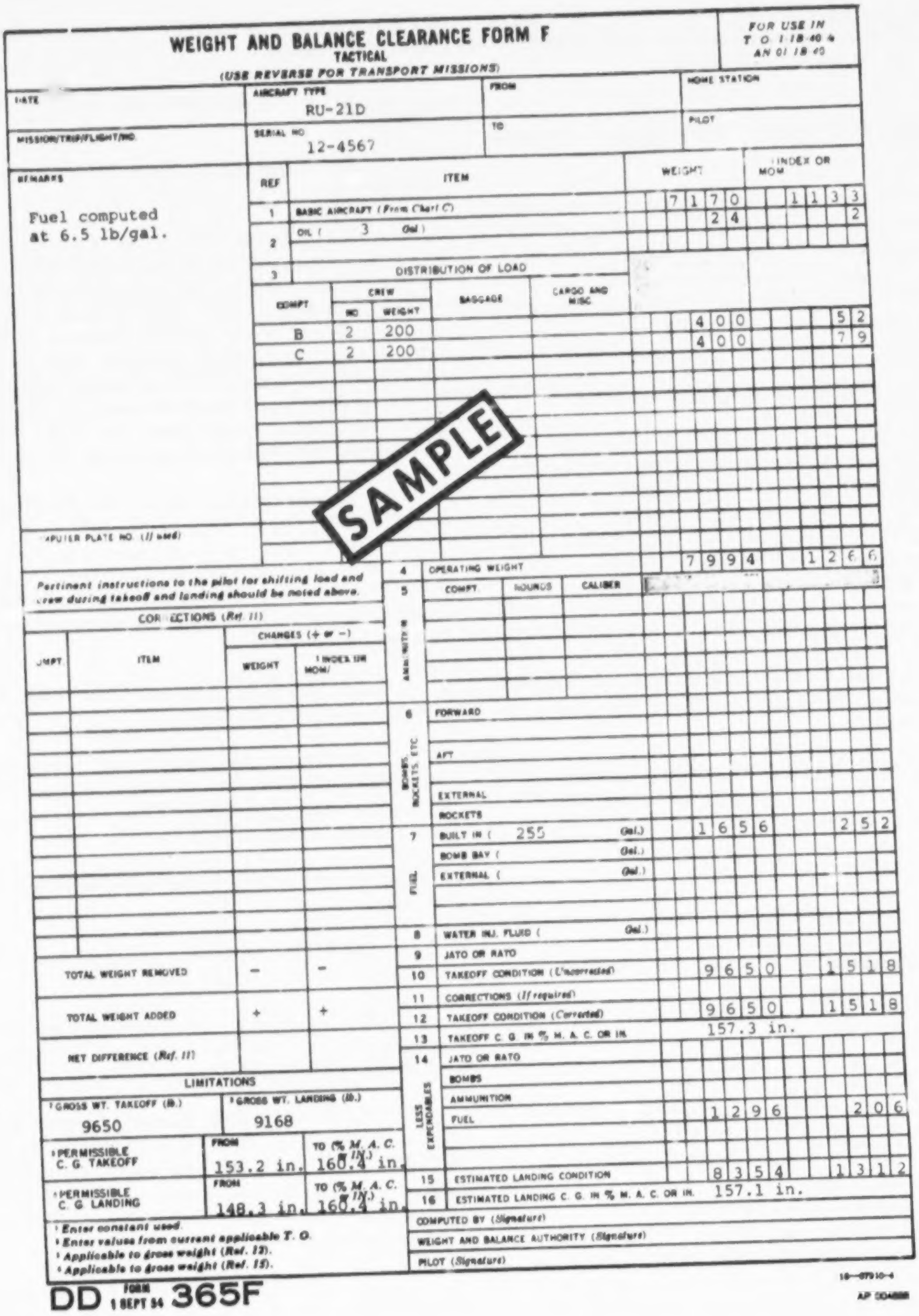
[1] GROSS WT. TAKEOFF (lb.) 10,200	[1] GROSS WT. LANDING (lb.) 9700	
[3] PERMISSIBLE C. G. TAKEOFF	FROM 146.4 in.	TO (% M. A. C. or IN.) 160.4 in.
[4] PERMISSIBLE C. G. LANDING	FROM 144.7 in.	TO (% M. A. C. or IN.) 160.4 in.

[1] *Enter constant used.*
[2] *Enter values from current applicable T. O.*
[3] *Applicable to gross weight (Ref. 12).*
[4] *Applicable to gross weight (Ref. 15).*

DD FORM 1 SEPT 54 365F

10-07910-4
AP 001618

Figure 6-5. Weight and Balance Clearance, DD Form 365F (Tactical) RU-21A



WEIGHT AND BALANCE CLEARANCE FORM F
TACTICAL
(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN
T. O. 1-1B-40 &
AN 01-1B-40

DATE	AIRCRAFT TYPE RU-21D	FROM	HOME STATION
MISSION/TRIP/FLIGHT/NO.	SERIAL NO. 12-4567	TO	PILOT

REMARKS
Fuel computed
at 6.5 lb/gal.

COMPUTER PLATE NO. *(If used)*

Pertinent instructions to the pilot for shifting load and crew during takeoff and landing should be noted above.

REF	ITEM	WEIGHT	[1] INDEX OR MOM
1	BASIC AIRCRAFT *(From Chart C)*	7170	1133
2	OIL (3 Gal.)	24	2
3	DISTRIBUTION OF LOAD		
4	OPERATING WEIGHT	7994	1266
5	AMMUNITION		
6	BOMBS, ROCKETS, ETC. FORWARD		
	AFT		
	EXTERNAL		
	ROCKETS		
7	FUEL BUILT IN (255 Gal.)	1656	252
	BOMB BAY (Gal.)		
	EXTERNAL (Gal.)		
8	WATER INJ. FLUID (Gal.)		
9	JATO OR RATO		
10	TAKEOFF CONDITION *(Uncorrected)*	9650	1518
11	CORRECTIONS *(If required)*		
12	TAKEOFF CONDITION *(Corrected)*	9650	1518
13	TAKEOFF C. G. IN % M. A. C. OR IN.	157.3 in.	
14	LESS EXPENDABLES JATO OR RATO		
	BOMBS		
	AMMUNITION		
	FUEL	1296	206
15	ESTIMATED LANDING CONDITION	8354	1312
16	ESTIMATED LANDING C. G. IN % M. A. C. OR IN.	157.1 in.	

DISTRIBUTION OF LOAD

COMPT	CREW NO	CREW WEIGHT	BAGGAGE	CARGO AND MISC	WEIGHT	INDEX OR MOM
B	2	200			400	52
C	2	200			400	79

AMMUNITION

COMPT.	ROUNDS	CALIBER

CORRECTIONS *(Ref. 11)*

COMPT.	ITEM	CHANGES (+ or −) WEIGHT	CHANGES (+ or −) [1] INDEX OR MOM
TOTAL WEIGHT REMOVED		−	−
TOTAL WEIGHT ADDED		+	+
NET DIFFERENCE *(Ref. 11)*			

LIMITATIONS

[2] GROSS WT. TAKEOFF (lb.) 9650	[2] GROSS WT. LANDING (lb.) 9168	
[3] PERMISSIBLE C. G. TAKEOFF	FROM 153.2 in.	TO (% *M. A. C. or IN.*) 160.4 in.
[4] PERMISSIBLE C. G. LANDING	FROM 148.3 in.	TO (% *M. A. C. or IN.*) 160.4 in.

[1] *Enter constant used.*
[2] *Enter values from current applicable T. O.*
[3] *Applicable to gross weight (Ref. 12).*
[4] *Applicable to gross weight (Ref. 15).*

COMPUTED BY *(Signature)*

WEIGHT AND BALANCE AUTHORITY *(Signature)*

PILOT *(Signature)*

DD FORM 1 SEPT 54 365F

SAMPLE

10—07910-4
AP 004888

Figure 6-6. Weight and Balance Clearance, DD Form 365F (Tactical) RU-21D

the aircraft unsafe to fly. The CG of the loaded aircraft must be within these limits at takeoff, in the air, and on landing.

6-10. Chart C – Basic Weight and Balance Record.

Chart C is a continuous history of the basic weight and moment resulting from structural and equipment changes made in service. At all times, the last weight and moment/1000 entry is considered the current weight and balance status of the basic aircraft (fig. 6-3 and 6-4).

6-11. Weight and Balance Clearance Form F, DD Form 365F (Tactical).

Form F (figs. 6-5 and 6-6) is a summary of the actual disposition of load in the aircraft. It records the balance status of the aircraft step by step. It serves as a work sheet to record weight and balance calculations and any corrections that must be made to insure that the aircraft will be within weight and CG limits. It is necessary to complete a Form F prior to flight when an aircraft is loaded in a manner for which no previous valid Form F is available. A copy must remain in the aircraft for the duration of the flight. Form F (Tactical) is completed as follows:

1. Insert necessary identifying information at top of form. In blank spaces of LIMITATIONS table, enter gross weights for takeoff and landing obtained from the WEIGHT LIMITATIONS paragraph in Chapter 5.

2. Ref 1. Enter aircraft basic weight and index or mom/1000 figure. Obtain this information from last entry on Chart C (fig. 6-3 and 6-4).

3. Ref 2. Enter amount, weight, and mom/1000 figure for oil. Refer to Section III for oil data.

4. Ref 3. Using compartment letter designations as shown in Aircraft Compartment and Station Diagram (fig. 6-1 or 6-2), enter number, weight, and mom/1000 figures of crew at their takeoff positions, baggage, cargo, and miscellaneous items. Use actual crew weights if available. Enter total of each compartment in WEIGHT and MOM/1000 columns. To determine pilot and copilot station locations and MOM/1000, use Personnel Moment Chart (fig. 6-7 or 6-8).

5. Ref. 4. Enter sum of weights and sum of mom/1000 figures for Ref 1 through Ref 3 to obtain OPERATING WEIGHT and corresponding mom/1000 figure.

6. Ref 5. Not applicable to RU-21A or RU-21D aircraft.

7. Ref 6. Not applicable to RU-21A or RU-21D aircraft.

8. Ref 7. Enter the number of gallons, weight and sum of mom/1000 figures for takeoff fuel. The weight of fuel used in warm up and taxiing should not be included. If JP-4 fuel at a density of 6.5 Lb/Gal is being used, use Fuel Moment Chart (fig. 6-9) to determine fuel weight and mom/1000 figures. If other than JP-4 is being used, use the following procedures to obtain accurate fuel weight and mom/1000 figures from the Fuel Moment Chart and to record information on Form F.

(1) Assume 6.7 Lb/Gal for JP-5 fuel or 6.0 Lb/Gal for AVGAS.

(2) Multiply the total number of gallons of fuel in the aircraft times the computed fuel density figure and thereby determine actual fuel weight.

(3) Use Fuel Moment Chart (fig. 6-9) to determine mom/1000 figure.

(4) Enter the weight and corresponding mom/1000 figure in the corresponding columns of Ref 7. Also, enter a figure for the total fuel gallons known to be in the aircraft.

9. Ref 8. Not applicable to RU-21A or RU-21D aircraft.

10. Ref 9. Not applicable to RU-21A or RU-21D aircraft.

11. Ref 10. Enter sum of weights and sum of mom/1000 figures for Ref 4 through Ref 9 opposite TAKEOFF CONDITION (uncorrected).

12. Check WEIGHT figure opposite Ref 10 against GROSS WT. TAKEOFF (lb) in LIMITATIONS table. Check index or mom/1000 figure opposite Ref 10 with Center-of-Gravity Limits Chart (fig. 6-10 or 6-11) to ascertain that CG is within allowable limits.

13. Ref 11. If changes in amount or distribution of loads are required, indicate necessary adjustments by proper entries in CORRECTIONS table. Enter a brief description of adjustment made in column marked ITEM. Add all weight and moment decreases and insert totals in

PERSONNEL MOMENTS

PERSONNEL MOMENTS
RU-21A
T74-CP-700

EXAMPLE

WANTED

PERSONNEL MOMENT

KNOWN

PERSONNEL WEIGHT = 190 POUNDS.
SEAT POSITION IS PILOT-COPILOT
SEAT (POSITION 1)

METHOD

ENTER WEIGHT AT EACH SEAT
POSITION HERE
MOVE RIGHT TO SEAT POSITION
MOVE DOWN, READ MOMENT = 24.5

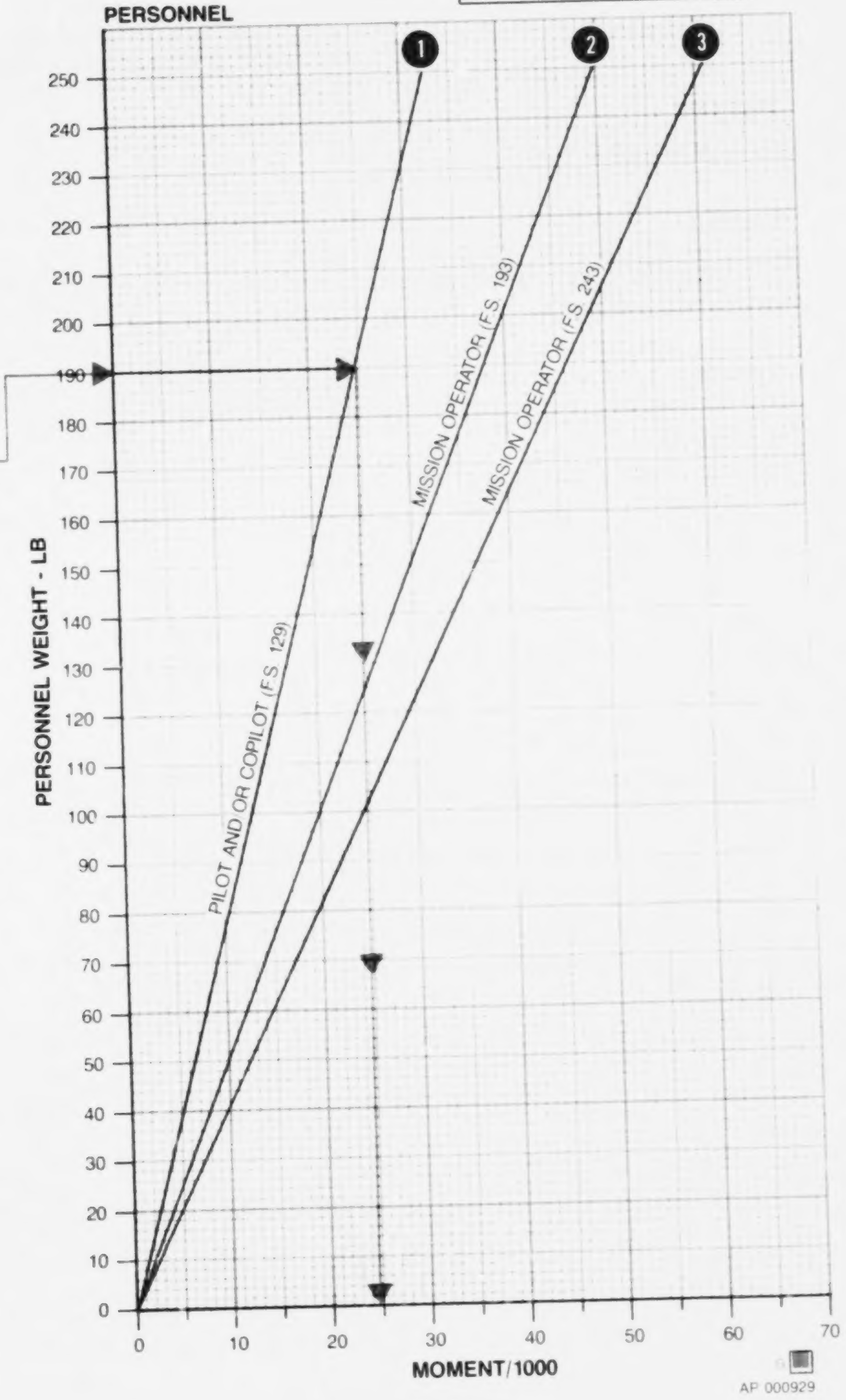


Figure 6-7. Personnel Moment Chart **RU-21A**

EXAMPLE

WANTED

PERSONNEL MOMENT

KNOWN

PERSONNEL WEIGHT = 220 POUNDS,
SEAT POSITION IS MISSION
OPERATOR SEAT (POSITION 5)

METHOD

ENTER WEIGHT AT EACH SEAT POSITION HERE
MOVE RIGHT TO SEAT POSITION
MOVE DOWN, READ MOMENT = 48.6

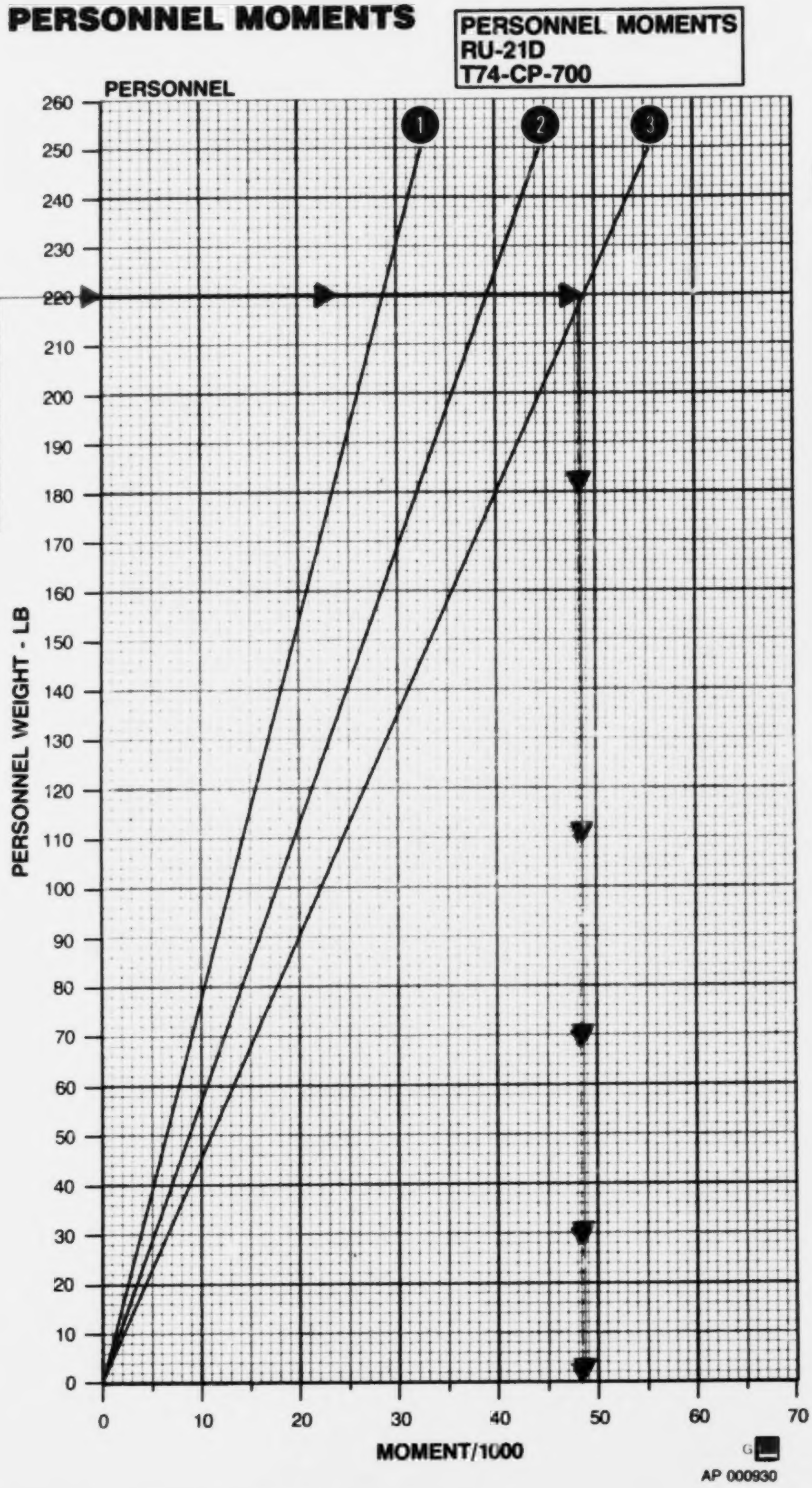


Figure 6-8. Personnel Moment Chart **RU-21D**

space opposite TOTAL WEIGHT REMOVED. Add all weight and moment increases and insert totals in space opposite TOTAL WEIGHT ADDED. Subtract smaller from larger of two totals and enter differences (with applicable + or − sign) opposite NET DIFFERENCE. Transfer these NET DIFFERENCE figures to spaces opposite Ref 11.

14. Ref 12. Enter sum of the difference between Ref 10 and Ref 11. Recheck against GROSS WT. TAKEOFF (lb) in LIMITATIONS table to assure that this figure does not exceed allowable limit.

15. Record figures in LIMITATIONS table as follows: In FROM space for PERMISSIBLE C.G. TAKEOFF enter an inches figure obtained as follows: Match weight figure recorded in Ref 12 with a corresponding figure in the GROSS WEIGHT-POUNDS on Center-of-Gravity Limits Chart (fig. 6-10 or 6-11). Determine the FWD LIMIT in inches figure for the weight matched and record in the FROM space stated. Enter AFT C.G. LIMIT in inches in "TO" space. Center-of-Gravity Limit Chart (fig. 6-10 or 6-11).

16. Ref 13. By referring to Center-of-Gravity Limits Chart (fig. 6-10 or 6-11), determine takeoff C.G. position. Enter this figure in space provided opposite TAKEOFF C.G. in inches. Insure that this position is within the FWD and AFT C.G. limit in LIMITATIONS table.

17. Ref 14. Enter estimated weight of fuel to be expended. Subtract this figure from weight of fuel on board (Ref 7). This figure represents the landing fuel weight. Use the Fuel Moment Chart (fig. 6-9) to determine landing fuel moment. Subtract the landing fuel moment from the total fuel moment on board (Ref 7). This figure represents the moment of fuel expended. Enter in Ref 14.

NOTE

Do not consider reserve fuel as expended when determining ESTIMATED LANDING CONDITION.

18. Ref 15. Enter differences in weights and moment/1000 figures between Ref 12 and total of Ref 14.

19. Record figures in LIMITATIONS table as follows: In "FROM" space for PERMISSIBLE C.G. LANDING, enter a figure obtained as follows: Match weight figure recorded in Ref 15 with a corresponding figure in the GROSS WEIGHT-POUNDS on Center-of-Gravity Limits Chart (fig. 6-10 or 6-11). Determine the FWD LIMIT in inches figure for the weight matched and record in the FROM space stated. Within the "TO" space for PERMISSIBLE C.G. LANDING, record the AFT C.G. LIMIT in inches.

20. Refer to C.G. Limits Chart (fig. 6-10 or 6-11) to determine landing C.G. position. Enter this figure in space provided opposite ESTIMATED LANDING C.G. in inches.

21. Check Ref 16 against PERMISSIBLE C.G. LANDING in LIMITATIONS table.

22. Necessary signatures must appear at bottom of form.

Section III. FUEL/OIL

6-12. Fuel and Oil Data.

This section contains the fuel and oil data necessary to compute aircraft weight and balance.

a. Fuel Moment Chart (fig. 6-9). This chart shows fuel moment/1000 Vs: U. S. gallons and pounds of JP-4 fuel.

b. Oil Data. The usable oil capacity for both engines is 3.0 gallons (24 pounds). (The unusable oil capacity is part of the basic weight of the aircraft.) The usable oil supply moment/1000 is 2, located at fuselage station 101.0. Oil weight is based on 8.0 pounds per gallon at Standard Day Temperature.

Section IV. CENTER OF GRAVITY

6-13. Center-Of-Gravity Limitations.

CAUTION

When oxygen bottles are not installed in the cabin, check aircraft loading to avoid exceeding forward CG limit. Flight operations involving forward loadings while the oxygen bottles are removed are critical, i.e., pilot and copilot only or forward loaded cargo and/or passengers.

a. RU-21A Limits. Center-of-gravity limitations (fig. 6-10) are expressed in ARM inches which refers to a positive measurement from the aircraft reference datum (fig. 6-1). The forward CG limit at 7850 lbs or less is 144.7 ARM inches. At 10,200 lbs., the forward CG limit is 152.3 ARM inches and a straight line variation is used between given points. The aft CG limit at 9650 lbs or less is 160.4 ARM inches. At 10,200 lbs, the aft CG limit is 159.2 ARM inches and a straight line variation is used between given points.

b. RU-21D Limits. Center-of-gravity limits (fig. 6-11) are expressed in ARM inches which refers to a positive measurement from the aircraft reference datum (fig. 6-2). The forward CG limit is 144.7 ARM inches for all weights below 7400 pounds and tapers to 153.2 ARM inches at 9650 pounds. The aft CG limit is 160.4 ARM inches at all weights.

FUEL MOMENT

FUEL MOMENT
RU-21A, RU-21D
T74-CP-700

NOTE

FUEL WEIGHT IS BASED ON 6.5 POUNDS PER GALLON AT STANDARD DAY TEMPERATURE

EXAMPLE

WANTED

FUEL MOMENT/1000

KNOWN

FUEL ON BOARD
1640 POUNDS

METHOD

ENTER FUEL
WEIGHT HERE
MOVE RIGHT
MOVE DOWN
READ FUEL
MOMENT/
1000 = 248

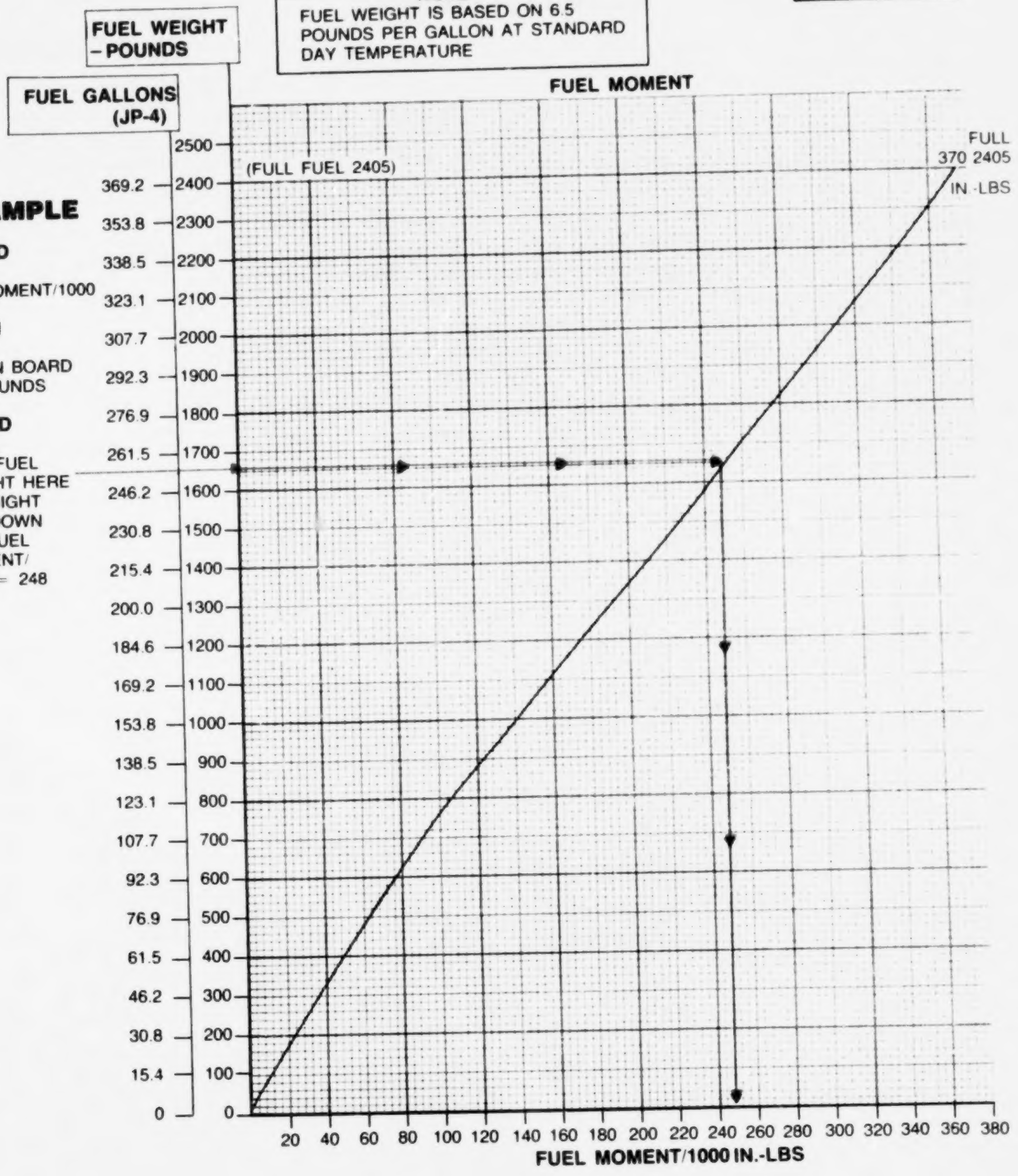


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Figure 6-9. Fuel Moment Chart

CENTER OF GRAVITY LIMITATIONS

CENTER OF GRAVITY LIMITATIONS
RU-21A
T74-CP-700

EXAMPLE

WANTED

DETERMINE IF LOADING LIMITS ARE EXCEEDED

KNOWN

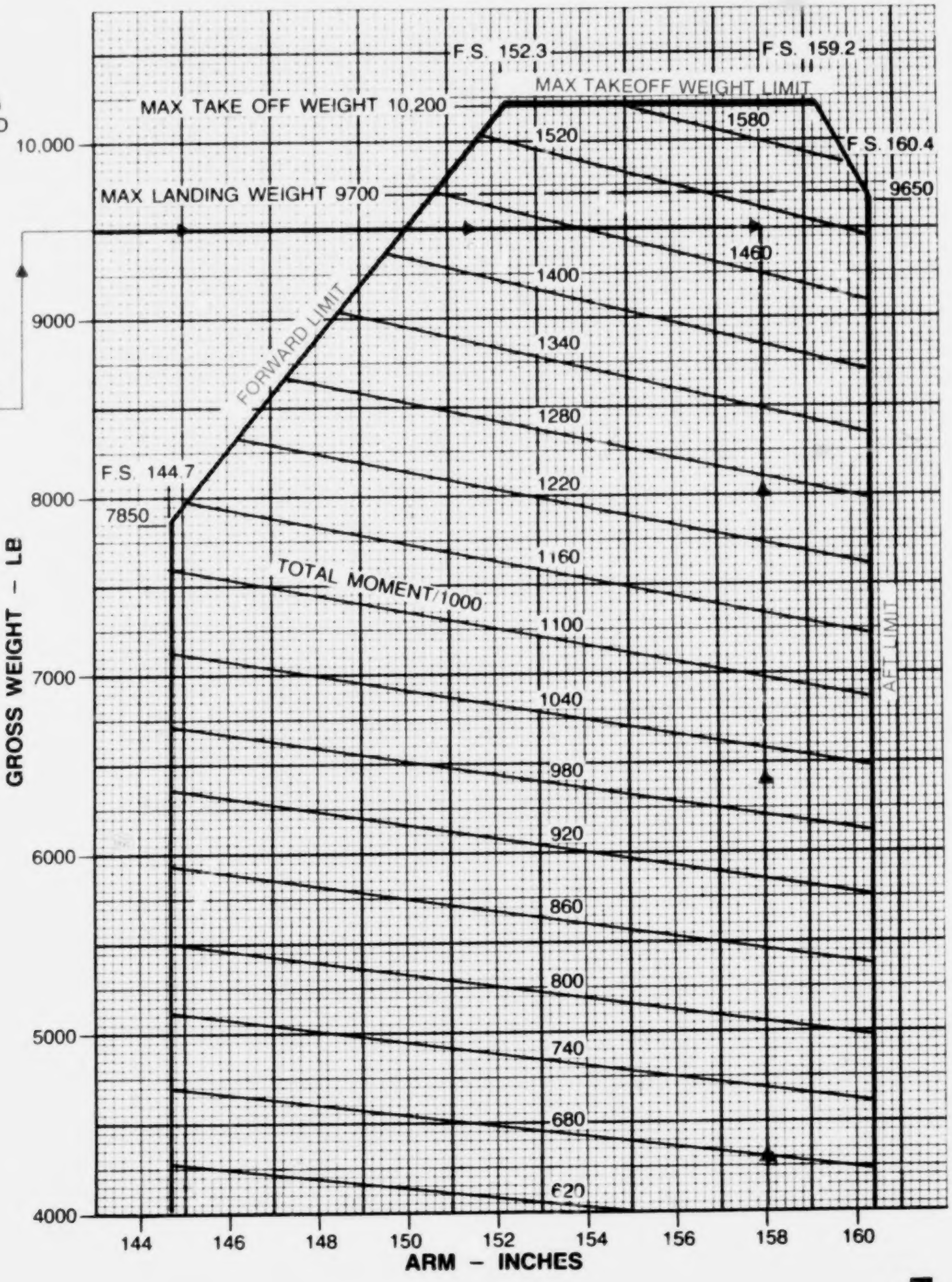
GW = 9500
MOMENT/1000 = 1501
ARM-INCHES = 158.0

METHOD

ENTER GROSS WEIGHT HERE
MOVE RIGHT TO INTERSECTION OF 9500 LBS AND 158 INCH ARM LINE

NOTE

THAT TOTAL MOMENT IS WITHIN LIMITS



AP 002541

Figure 6-10. Center of Gravity RU-21A

CENTER OF GRAVITY LIMITATIONS

CENTER-OF-GRAVITY LIMITATIONS
RU-21D
T74-CP-700

EXAMPLE

WANTED

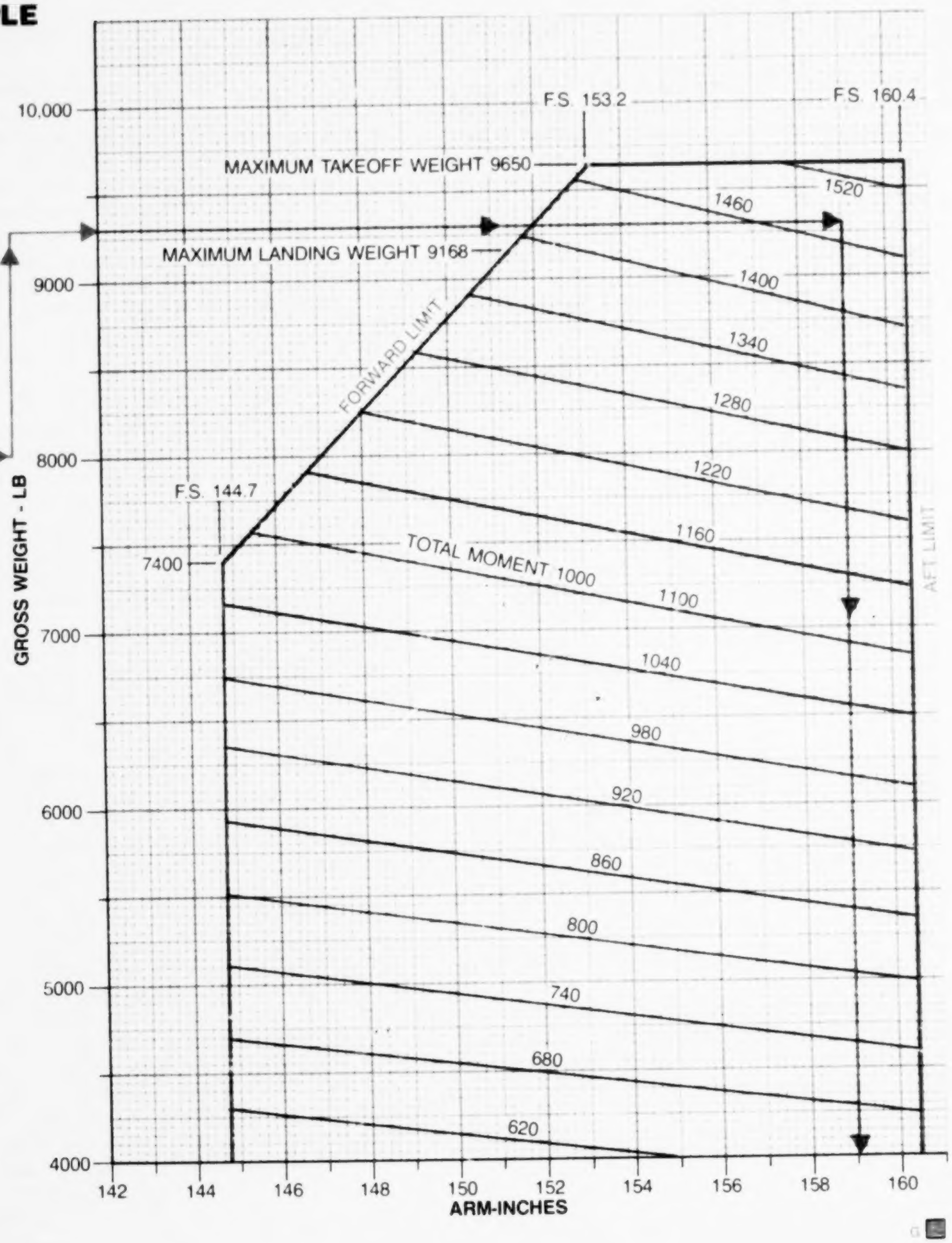
DETERMINE IF LOADING LIMITS ARE EXCEEDED

KNOWN

GW = 9300
MOMENT/1000 = 1479
ARM-INCHES = 159.0

METHOD

ENTER GROSS WEIGHT HERE
MOVE RIGHT TO TOTAL MOMENT = 1479, READ LOAD WITHIN LIMITS
MOVE DOWN READ ARM = 159.0



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AP 002539

Figure 6-11. Center of Gravity **RU-21D**

CHAPTER 7

PERFORMANCE DATA

Section I. INTRODUCTION

7-1. Description.

The charts presented in this chapter are based on and are consistent with the recommended operating procedures and techniques set forth in other chapters of this manual. The charts contain the performance data necessary for preflight and inflight mission planning. Explanatory text applicable to each type of chart is included to illustrate the use of the data presented.

7-2. Purpose.

a. The purpose of this chapter is to provide the best available performance data for the RU-21A and RU-21D aircraft. Regular use of this information will enable the pilot to receive maximum safe utilization from the aircraft. Although maximum performance is not always required, regular use of this chapter is recommended for the following reasons:

(1) Knowledge of performance margins will allow the pilot to make better decisions when unexpected conditions or alternate missions are encountered.

(2) Situations requiring maximum performance will be more readily recognized.

(3) Familiarity with the data will allow performance to be computed more easily and quickly.

(4) Experience will be gained in accurately estimating the effects of variables for which data are not presented.

b. The information is primarily intended for mission planning and is most useful when planning operations in unfamiliar areas or at extreme conditions. The data may also be used inflight, to establish unit or area standing operating procedures, and to inform ground commanders of performance/risk tradeoffs.

7-3. General.

The data presented shall cover the maximum range of conditions and performance that can reasonably be expected. In each area of performance, the effects of altitude, temperature, gross weight, and other parameters relating to that phase of flight are presented. In addition to the presented data, the pilot's judgement and experience will be necessary to accurately obtain performance under a given set of circumstances. The conditions for the data are listed under the title of each chart. The effects of different conditions are discussed in the text accompanying each phase of performance. Where practical, data is presented at conservative conditions. However, NO GENERAL CONSERVATISM HAS BEEN APPLIED.

WARNING

Exceeding operating limits may cause permanent damage to critical components. Overlimit operation can decrease performance, cause immediate failure, or failure on a subsequent flight.

7-4. Limits.

Applicable limits are shown on the charts as red lines. Performance generally deteriorates rapidly beyond limits. If limits are exceeded, minimize the amount and time. Enter the maximum value and time above limits on DA Form 2408-13 so proper maintenance action can be taken.

7-5. Chart Explanation.

A complete series of performance charts are provided for the RU-21A and RU-21D aircraft in this manual. These charts furnish the pilot with sufficient data to make an intelligent and safe flight plan. The charts include data on takeoff, climb, landing, and operating instructions for cruising flight from maximum endurance to normal rated power. No allowance has been made for navigational error, formation flight, or other contingencies. Appropriate allowances for these items should be dictated by local regulations and should be accounted for when the fuel available for cruise is determined. The charts are arranged to give maximum facility of use in preflight and

7-6. Chapter 7 Index.

SECTION	TITLE	FIGURE NUMBER	CHART SUBJECT	PAGE NO.
I	Introduction	N/A	N/A	
II	Performance Planning	7-1	Performance Planning Card	7-7
		7-2	Temperature Conversion/Correction	7-9
		7-3	Airspeed Calibration - Normal System	7-12
		7-4	Altimeter Correction - Emergency System	7-13
		7-5	Altimeter Calibration - Normal System	7-14
		7-6	Altimeter Correction - Emergency System	7-15
III	Crosswind - Takeoff or Landing	7-7	Crosswind - Takeoff or Landing (RU-21A)	7-17
IV	Idle Fuel Flow	7-9	Idle Fuel Flow	7-21
V	Torque Available for Takeoff	7-23	Torque Available LTCfor Takeoff	7-23
VI	Normal Takeoff	7-11	Takeoff - Normal (RU-21A)	7-25
		7-12	Takeoff - Normal (RU-21D)	7-27
VII	Normal Rotation/ Takeoff Airspeed	7-13	Normal Rotation/Takeoff Airspeed (RU-21A)	7-29
		7-14	Normal Rotation/Takeoff Airspeed (RU-21D)	7-31
VIII	Acceleration Check	7-15	Acceleration Check (RU-21A)	7-33
		7-16	Acceleration Check (RU-21D)	7-35
IX	Accelerate - Stop Distance	7-17	Accelerate - Stop (RU-21A)	7-37
		7-18	Accelerate - Stop (RU-21D)	7-39
X	Minimum Single-Engine Control Airspeed	7-19	Minimum Single-Engine Control Airspeed (RU-21A)	7-41
		7-20	Minimum Single-Engine Control Airspeed (RU-21D)	7-43
XI	Single-Engine Climb	7-21	Single-Engine Climb (RU-21A)	7-45
		7-22	Single-Engine Climb (RU-21D)	7-47
XII	Operation Envelope	7-23	Operation Envelope (RU-21A)	7-49
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inflight planning. All charts are based on free air temperature (FAT) conditions and pressure altitude.

7-7. Color Coding.

The performance charts are color coded as follows:

a. Green: For example guidelines.

b. Red: Limit lines.

c. Yellow: Precautionary or time-limited operation.

7-8. Reading The Charts.

The primary use of each chart is given in an example and a green guideline is provided to help the pilot follow the route through the chart. The use of a straight edge (ruler or page edge) and a hard fine point pencil is recommended to avoid cumulative errors. The majority of the charts provide a standard pattern for use as follows: enter first variable on top left scale, move right to the second variable, reflect down at right angles to the third variable, reflect left at right angles to the fourth variable, reflect down, etc. until the final variable is read out at the final scale. In addition to the primary use, other uses of each chart are explained in the text accompanying each set of performance charts. Colored registration blocks located on the bottom and top of each chart are used to determine if slippage has occurred during printing. If slippage has occurred, refer to chapter 5 for correct operating limits.

7-9. Data Basis.

The type of data used is indicated at the bottom of each performance chart under DATA BASIS. The applicable report and date of the data are also given. The data provided generally is based on one of three categories:

a. Flight test data. Data obtained by flight test of the aircraft by experienced flight test personnel at precise conditions using sensitive calibrated instruments.

b. Calculated data. Data based on tests, but not on flight test of the complete aircraft.

c. Estimated data. Data based on estimates using aerodynamic theory or other means but not verified by flight test.

7-10. Specific Conditions.

The data presented is accurate only for specific conditions listed under the title of each chart. Variables for which data is not presented, but which may affect that phase of performance, are discussed in the text. Where data is available or reasonable estimates can be made, the amount that each variable affects performance will be given.

7-11. General Conditions.

The following general conditions might have deteriorating effects on the aircraft performance: atmospheric humidity, fuel flow, rigging, pilot technique, aircraft variation, engine variation, and instrument variation.

7-12. Performance Discrepancies.

Regular use of this chapter will allow the pilot to monitor instrument and other aircraft systems for malfunction, by comparing actual performance with planned performance. Knowledge will also be gained concerning the effects of variables for which data is not provided, thereby increasing the accuracy of performance predictions.

Section II. PERFORMANCE PLANNING

7-13. Performance Planning Card (PPC).

This card (fig. 7-1), is provided to assist the pilot in recording data applicable to the mission and may be reproduced at the local level. This does not preclude the use of locally developed cards. The PPC provides readily available information for departure, climb, cruise, arrival and prevailing conditions. Pertinent data required to fill in the blanks on the PPC shall be computed from the performance charts and tables contained in this chapter, and from existing conditions at time of takeoff or landing. The takeoff and landing data shall be computed prior to takeoff, as a precaution against emergency conditions which could develop after takeoff. The following blocks are provided on the front of the PPC for entry of data as applicable:

a. *Weather Data.*

(1) PA (pressure altitude).

(2) FAT (free air temperature).

(3) WIND (speed and direction).

(4) RWY (runway heading, length and slope).

b. *Aircraft Data.*

(1) T/O WT (takeoff weight).

(2) LDG WT (landing weight).

c. *Performance Data.*

(1) T/O PWR (torque).

(2) T/O RUN (no obstacle or obstacle clearance (if required)).

(3) ACC-STOP (accelerate-stop distance).

(4) V_{mc} (minimum single engine control airspeed).

(5) V_r-V_{lof} (Rotation airspeed and liftoff airspeed).

(6) V_x-V_y (best angle of climb and best rate of climb).

(7) V_{yse} (single engine best rate of climb).

(8) V_{ref} (landing speed).

(9) LDG RUN.

(10) Additional data as required.

7-14. Performance Planning Sequence.

The following information may be extracted from the charts in this chapter.

NOTE

The pressure altitude may be determined by setting the altimeter to 29.92 and reading the pressure altitude, or by adding 100 feet to the field elevation for each 0.1 in. Hg. below 29.92, or by subtracting 100 feet from the field elevation for each 0.1 in. Hg. above 29.92.

a. *Preflight Planning.*

(1) Determine the following conditions for each phase of the flight, as appropriate, before entering the performance charts and enter the information on the PPC.

(a) Pressure altitude.

(b) Free air temperature.

(c) Wind.

(d) Aircraft weight (both takeoff and landing).

NOTE

Weight and balance blocks are provided on the rear of the PPC and should be utilized to determine exact weight and loading conditions prior to computing takeoff and landing data. Weight information may be obtained from either chart C or the current Form 365F.

(e) Obstacles (if applicable).

(f) Ceiling and visibility.

FW PERFORMANCE PLANNING (PPC)

TCs 1-144 1-145 (draft)

PA	FAT
RWY	WIND
T/O WT	LDG WT

T/O PWR	
T/O RUN	
ACC-STOP	
V_{mc}	
V_r-V_{lof}	/
V_x-V_y	/
V_{yse}	
V_{ref}	
LDG RUN	

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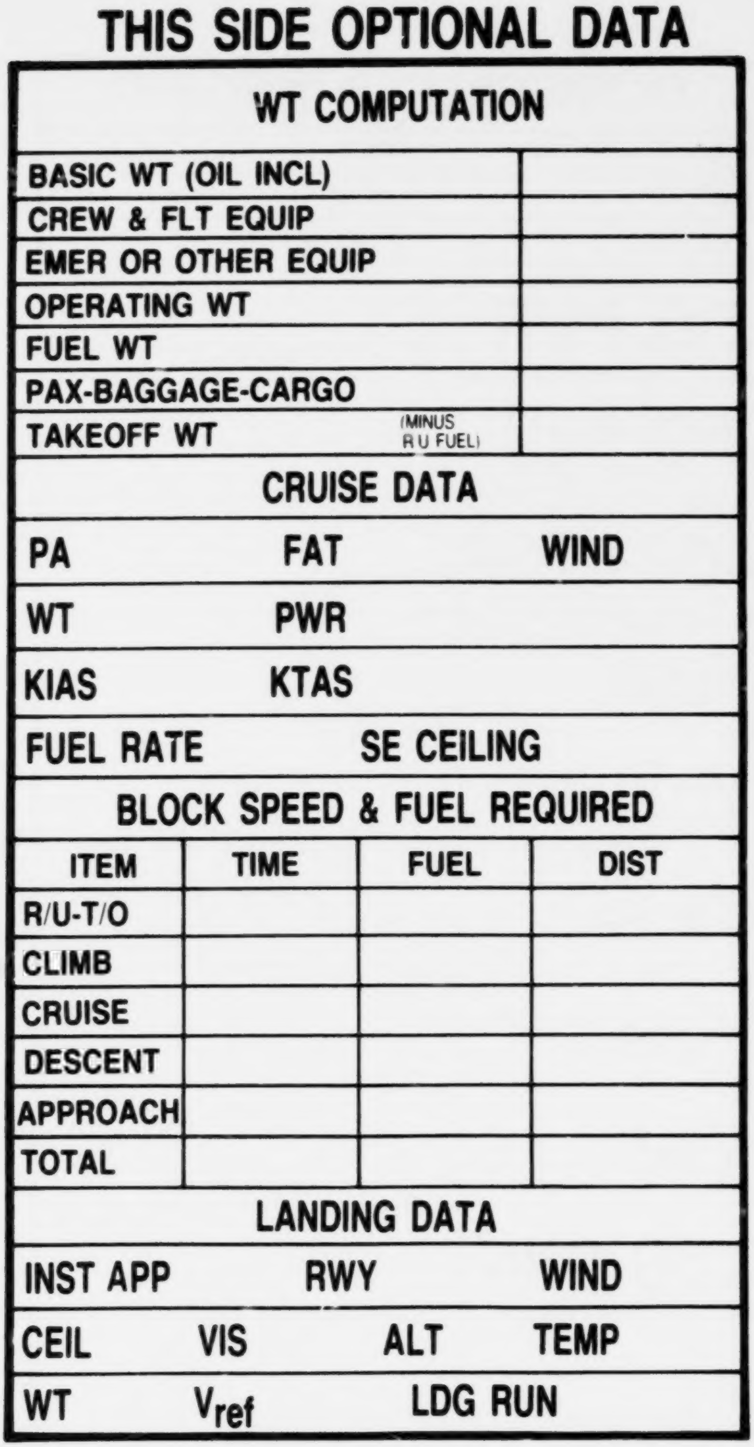
Figure 7-1. Performance Planning (Sheet 1 of 2)



THIS SIDE OPTIONAL DATA

WT COMPUTATION

BASIC WT (OIL INCL)	
CREW & FLT EQUIP	
EMER OR OTHER EQUIP	
OPERATING WT	
FUEL WT	
PAX-BAGGAGE-CARGO	
TAKEOFF WT (MINUS R U FUEL)	

CRUISE DATA

PA FAT WIND

WT PWR

KIAS KTAS

FUEL RATE SE CEILING

BLOCK SPEED & FUEL REQUIRED

ITEM	TIME	FUEL	DIST
R/U-T/O			
CLIMB			
CRUISE			
DESCENT			
APPROACH			
TOTAL			

LANDING DATA

INST APP RWY WIND

CEIL VIS ALT TEMP

WT V_{ref} LDG RUN

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Figure 7-1. Performance Planning Card (Sheet 2 of 2)

TEMPERATURE CONVERSION/CORRECTION

TEMPERATURE CONVERSION
/CORRECTION
RU-21A, RU-21D
T74-CP-700

EXAMPLE

WANTED

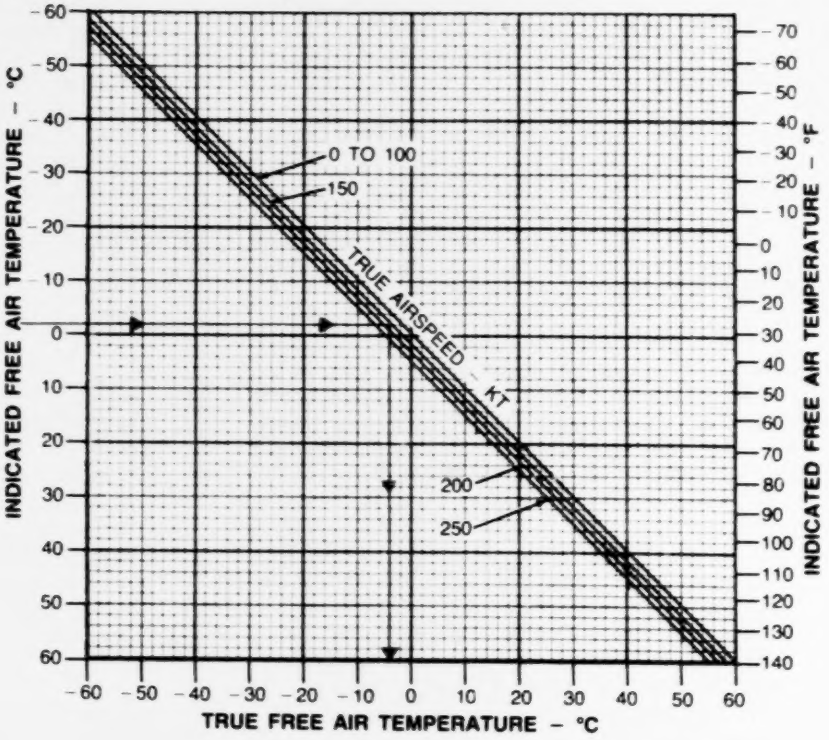
TRUE FAT

KNOWN

INDICATED FAT = -2°C
TRUE AIRSPEED = 154 KT

METHOD

ENTER INDICATED FAT HERE
MOVE RIGHT TO TRUE AIRSPEED
MOVE DOWN READ TRUE
FAT = -4°C



AP 001611

Figure 7-2. Temperature Conversion Correction

(g) Instrument departure and approach procedures.

(h) Hazards.

(2) Determine the following conditions from the performance charts and enter the information on the PPC blocks provided.

(a) T/O PWR – Takeoff power. Obtain from TORQUE AVAILABLE FOR TAKEOFF chart.

(b) T/O RUN – Take off distance. Obtain from TAKEOFF-NORMAL chart.

(c) ACC-STOP – Accelerate-stop distance. Obtain from ACCELERATE-STOP DISTANCE chart. An ACCELERATE-CHECK chart is provided for optional use during critical length takeoffs.

(d) V_{mc} – Minimum single engine control airspeed. Obtain from MINIMUM SINGLE ENGINE CONTROL AIRSPEED (V_{mc}) chart.

(e) V_r-V_{lof} – Rotation airspeed and liftoff airspeed. Obtain from NORMAL ROTATION/TAKEOFF AIRSPEED chart.

(f) V_x-V_y – Best angle of climb airspeed and best rate of climb airspeed. Obtain V_x from NORMAL ROTATION/TAKEOFF AIRSPEED chart (obstacle clearance airspeed). Obtain V_y from the MAX R/C LINE (two engine) using the appropriate CRUISE chart.

NOTE

For the purposes of this manual Vx will be approximated by the obstacle clearance climb airspeed obtained using the Normal Rotation/Takeoff Airspeed chart.

(g) V_{yse} – Best single engine rate of climb. Obtain from appropriate CRUISE chart.

(h) V_{ref} – Landing approach airspeed. Obtain from APPROACH SPEED chart. This airspeed shall be computed for landing immediately after takeoff in the event of an emergency.

(i) LDG RUN – Landing distance. Obtain from Landing chart. This distance shall be computed for landing immediately after takeoff in the event of an emergency.

(3) After the takeoff and landing data has been logged, evaluate the performance/risk trade-off of the following:

1. Crosswind conditions.

2. Takeoff, accelerate stop and landing distances.

3. Obstacle clearance in the event of engine failure.

b. Rear of PPC.

(1) Cruise Data. Space is provided on the rear of the PPC for such information as pressure altitude (PA), free air temperature (FAT), wind speed and direction (WIND), aircraft weight (WT), power required (PWR), airspeed (KIAS and KTAS), fuel flow (FUEL RATE) and single engine ceiling (SE CEILING). Power, airspeed and fuel rate may be obtained from the Cruise charts. Single engine ceiling may be obtained from the Operation Envelope chart.

NOTE

BLOCK SPEED AND FUEL REQUIRED space is provided on the rear of the PPC for use as required. Performance charts are available for climb and cruise information. Descent information may be obtained by interpolating between Cruise charts and the Climb/Descent chart. The approach spaces may be utilized to compute total time/fuel/and distance to actual landing.

(2) Landing Data. Space is provided on the rear of the PPC for entry of landing data. This information should be computed prior to landing and reflect actual landing weight so the landing approach speed (V_{ref}) and landing distance will be correct. The instrument approach in use and current weather conditions may also be entered.

7-15. Performance Information.

Performance information obtained may make it necessary to alter gross weight, airspeed, altitude, or other variables in order to safely operate the aircraft. If any of these variables are changed on one chart, corresponding changes will be necessary on all other charts where that information is used.

7-16. Airspeed Position Error Correction.

The relationship between indicated airspeed and calibrated airspeed for various flap settings is shown for the normal static air source.

NOTE

Indicated airspeed assumes a zero instrument error, also, no significant change in airspeed position correction is apparent due to power settings, altitude or landing gear position. All airspeed calibrations were conducted in level flight and may not be appropriate for stall.

7-17. Altimeter Position Error Correction.

The altitude corrections to be made to the altimeter reading are shown for various altitudes and flap positions for the normal static air source.

NOTE

Indicated altitude assumes a zero instrument error, also, no significant change in position error correction is apparent due to power settings or landing gear position.

AIRSPEED CALIBRATION – NORMAL SYSTEM

AIRSPEED CALIBRATION
NORMAL SYSTEM
RU-21A, RU-21D
T74-CP-700

EXAMPLE

WANTED

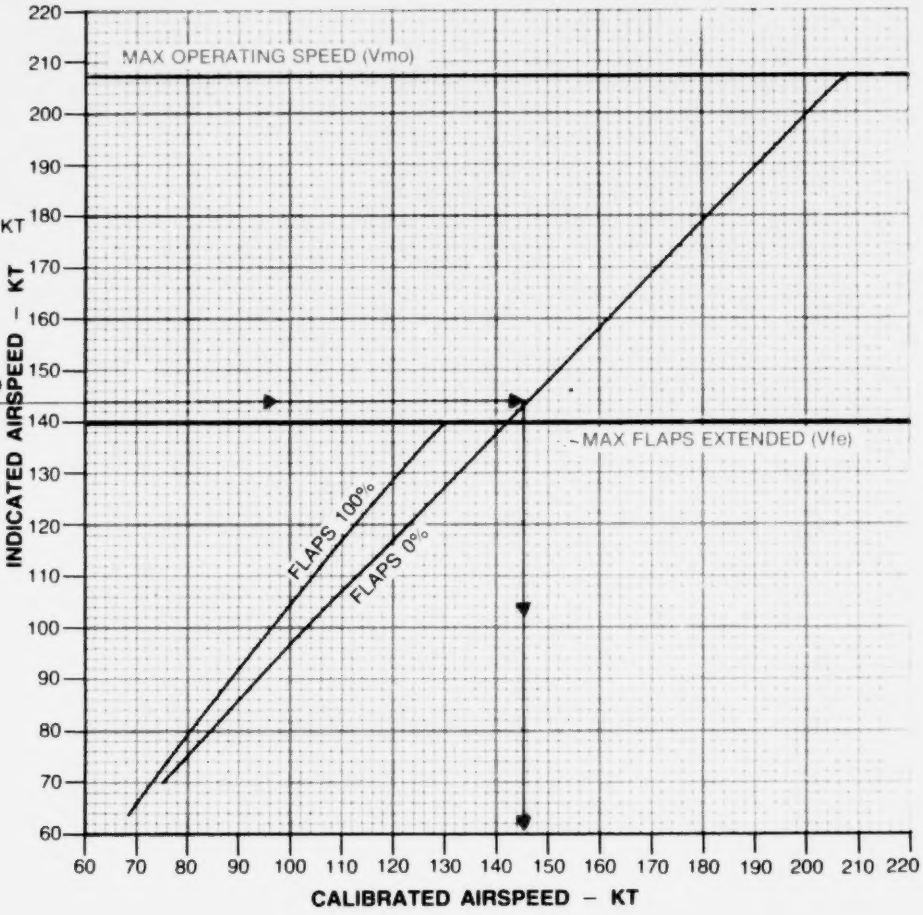
CALIBRATED AIRSPEED

KNOWN

INDICATED AIRSPEED = 143 KT
FLAP SETTING = 0%

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO FLAP SETTING
MOVE DOWN, READ CALIBRATED AIRSPEED = 145 KT



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 001612

Figure 7-3. Airspeed Calibration – Normal System

AIRSPEED CALIBRATION – EMERGENCY SYSTEM

**AIRSPEED CALIBRATION
EMERGENCY SYSTEM
RU-21A, RU-21D
T74-CP-700**

EXAMPLE

WANTED

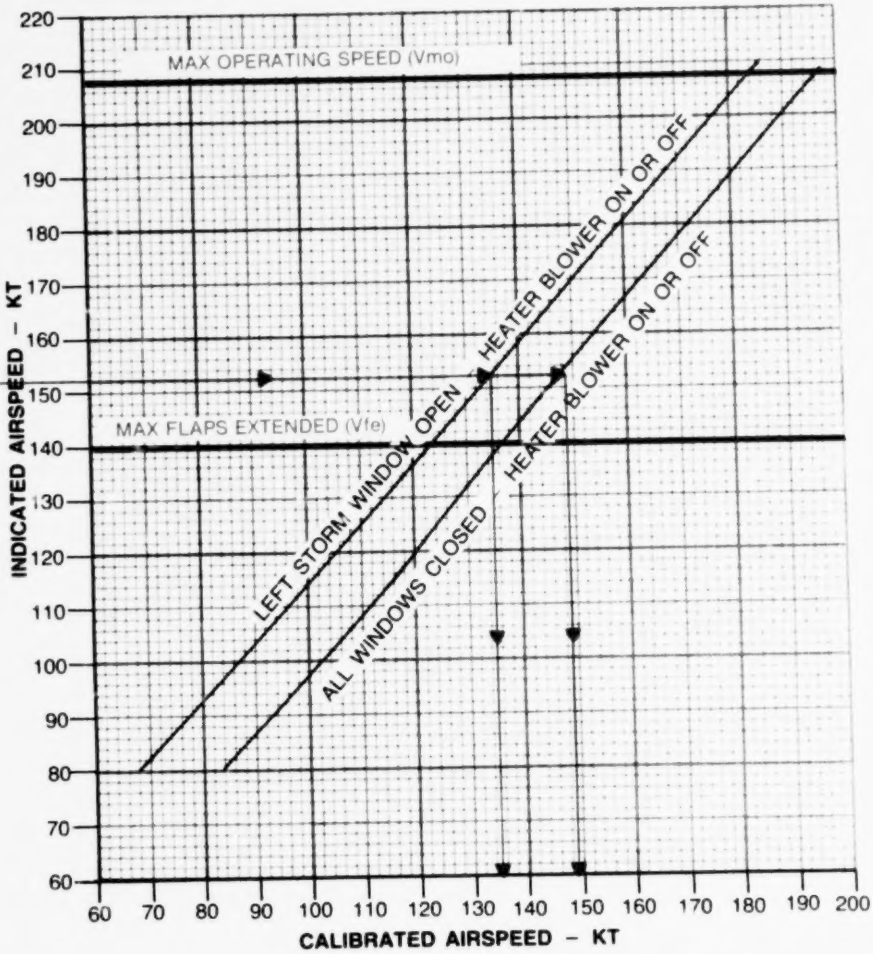
CALIBRATED AIRSPEED

KNOWN

INDICATED AIRSPEED = 153 KT
LEFT STORM WINDOW OPEN, OR, ALL WINDOWS CLOSED

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO STORM WINDOW OPEN
MOVE DOWN, READ CALIBRATED AIRSPEED = 135 KT
MOVE RIGHT TO ALL WINDOWS CLOSED
MOVE DOWN, READ CALIBRATED AIRSPEED = 149 KT



AP 001614

DATA BASIS: DERIVED FROM FLIGHT TEST

Figure 7-4. Airspeed Calibration – Emergency System

ALTIMETER CORRECTION – NORMAL SYSTEM

ALTIMETER CORRECTION
NORMAL SYSTEM
RU-21A, RU-21D
T74-CP-700

EXAMPLE

WANTED

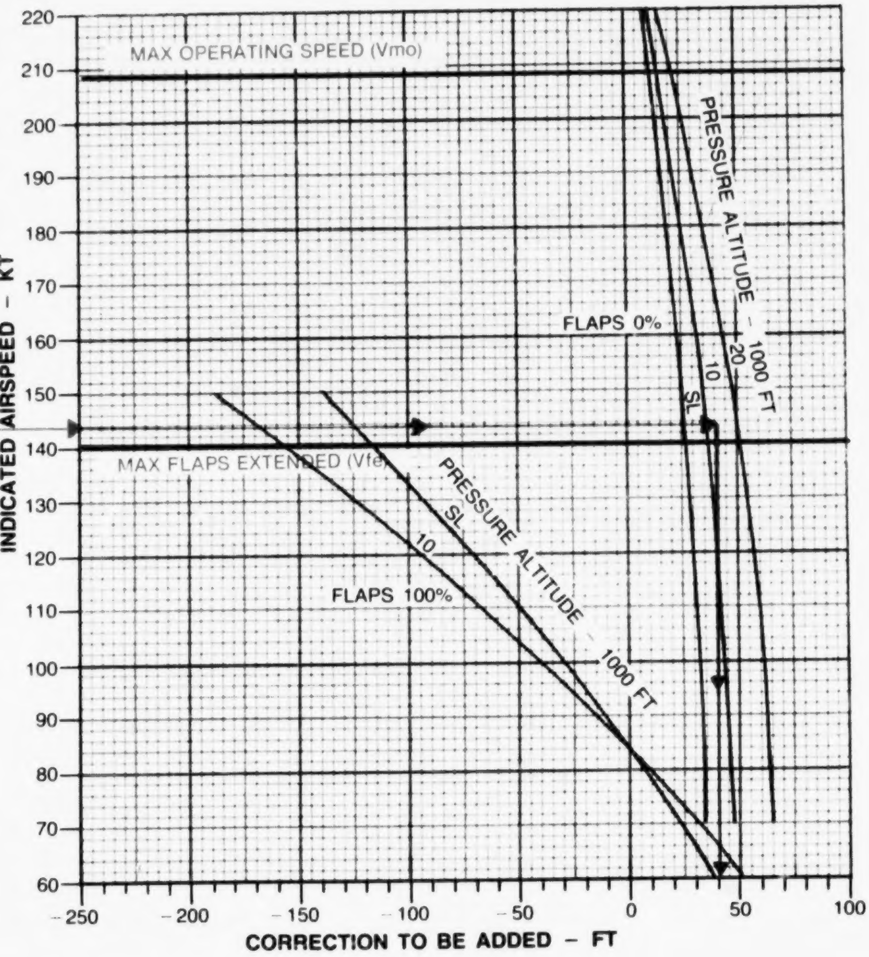
CORRECTED ALTITUDE

KNOWN

INDICATED ALTITUDE = 12,000 FT
INDICATED AIRSPEED = 143 KT
PRESSURE ALTITUDE = 12,000 FT
FLAPS SETTING = 0%

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO PRESSURE ALTITUDE FOR FLAP SETTING
MOVE DOWN, READ ALTITUDE CORRECTION = 40FT
CORRECTED ALTITUDE = (INDICATED ALTITUDE + CORRECTION) = 12,040 FT



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 001613

Figure 7-5. Altimeter Calibration – Normal System

ALTIMETER CORRECTION-EMERGENCY SYSTEM

ALTIMETER CORRECTION
EMERGENCY SYSTEM
RU-21A, RU-21D
T74-CP-700

EXAMPLE

WANTED

CORRECTED ALTIMETER CORRECTION

KNOWN

INDICATED ALTITUDE = 10,000 FT
INDICATED AIRSPEED = 153 KT
PRESSURE ALTITUDE = 12,000 FT
ALL WINDOWS CLOSED

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN, READ ALTITUDE
CORRECTION = 105 FT CORRECTED
ALTITUDE = (INDICATED +
CORRECTION) = 12,105 FT

DATA BASIS: FLIGHT TEST

WANTED

CORRECTED ALTIMETER CORRECTION

KNOWN

INDICATED ALTITUDE = 12,000 FT
INDICATED AIRSPEED = 153 KT
PRESSURE ALTITUDE = 12,000 FT
LEFT STORM WINDOW OPEN

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN READ ALTITUDE
CORRECTION = 430 FT
CORRECTED ALTITUDE = (INDICATED
+ CORRECTION) = 12,430 FT

DATA BASIS: FLIGHT TEST

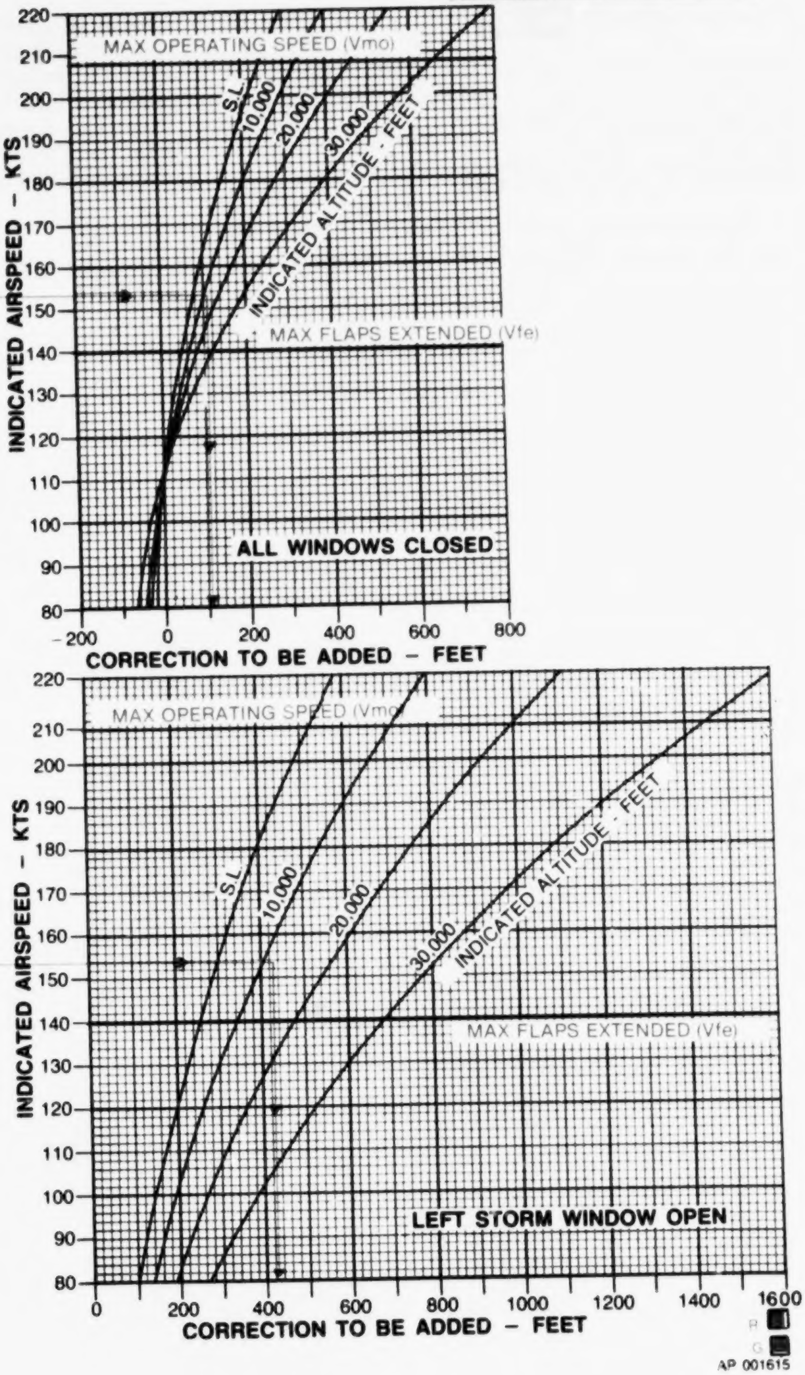


Figure 7-6. Altimeter Correction - Emergency System

Section III. CROSSWIND – TAKEOFF OR LANDING

7-18. Description. RU-21A

The Crosswind Chart (fig. 7-7) shows the crosswind conditions under which a takeoff or landing is not recommended.

7-19. Use of Chart. RU-21A

Recommended rotation airspeed is obtained from the Normal Rotation/Takeoff Airspeed Chart (fig. 7-13). Takeoff should not be attempted when the rotation speed intercept point falls within the non-recommended area. Select a touchdown airspeed less than the approach airspeed obtained from the Approach Speed Chart (fig. 7-126) such that the touchdown airspeed falls within the recommended area.

CROSSWIND – TAKEOFF OR LANDING

CROSSWIND TAKEOFF
OR LANDING
RU-21A
T74-CP-700

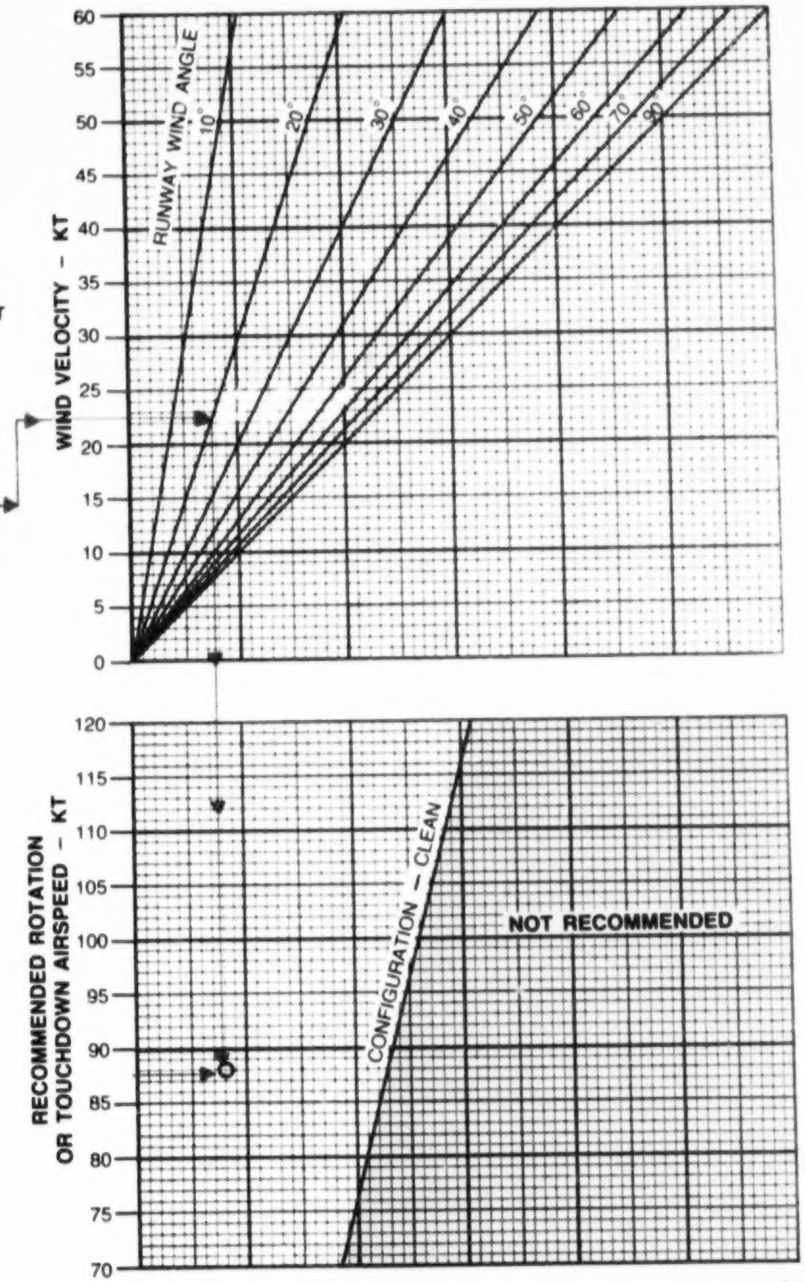
EXAMPLE

KNOWN

CLEAN CONFIGURATION
RUNWAY 21
WIND VELOCITY = 23 KT
WIND DIRECTION = 190°
NORMAL ROTATION AIRSPEED = 88 KT

METHOD

DETERMINE RUNWAY WIND ANGLE
210° – 190° = 20°
ENTER WING VELOCITY HERE
MOVE RIGHT TO RUNWAY WIND ANGLE = 20°
MOVE DOWN TO NORMAL ROTATION AIRSPEED LINE = 88 KT
THE INTERSECTION POINT FALLS WITHIN THE RECOMMENDED AREA



AP 001342

DATA BASIS: ESTIMATED

Figure 7-7. Crosswind - Takeoff or Landing RU-21A

7-20. Description. RU-21D

The Crosswind Chart (fig. 7-8) shows the crosswind conditions under which a takeoff or landing is not recommended.

7-21. Use of Chart. RU-21D

Recommended rotation airspeed is obtained from the Normal Rotation/Takeoff Airspeed Chart (fig. 7-14). Takeoff should not be attempted when the rotation speed intercept point falls within the non-recommended area. Select a touchdown airspeed less than the approach airspeed obtained from the Approach Speed Chart (fig. 7-127) such that the touchdown airspeed falls within the recommended area.

CROSSWIND – TAKEOFF OR LANDING

CROSSWIND TAKEOFF
OR LANDING
RU-21D
T74-CP-700

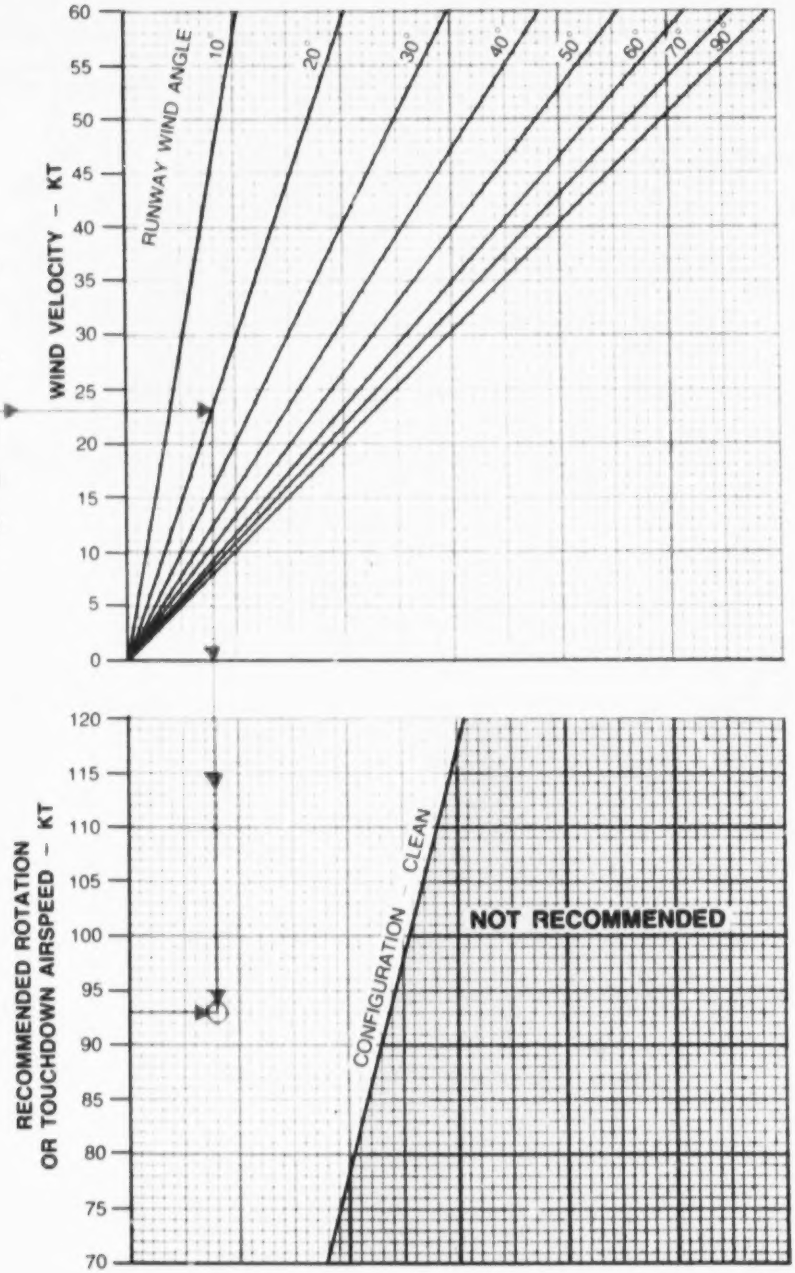
EXAMPLE

KNOWN

CLEAN CONFIGURATION
RUNWAY 21
WIND VELOCITY = 23 KT
WIND DIRECTION = 190°
NORMAL ROTATION AIRSPEED = 93 KT

METHOD

DETERMINE RUNWAY WIND ANGLE. 210° – 190° = 20°
ENTER WING VELOCITY HERE
MOVE RIGHT TO RUNWAY WIND ANGLE = 20°
MOVE DOWN TO NORMAL ROTATION AIRSPEED LINE = 93 KTS
THE INTERSECTION FALLS WITHIN THE RECOMMENDED AREA



DATA BASIS: FLIGHT TEST

AP 000844

Figure 7-8. Crosswind - Takeoff or Landing **RU-21D**

Section IV. IDLE FUEL FLOW

7-22. Description.

The Idle Fuel Flow Chart (fig. 7-9) shows idle fuel flow in pounds per hour at various altitudes and FAT.

7-23. Use of Chart.

NOTE

Fuel flow values should be doubled for two engine operation.

7-24. Conditions.

All fuel flow data is based on JP-4 aviation fuel. Variation in fuel temperature may change the fuel flow values slightly.

IDLE FUEL FLOW

JP-4 FUEL

IDLE FUEL FLOW
RU-21A, RU-21D
T74-CP-700

EXAMPLE

WANTED

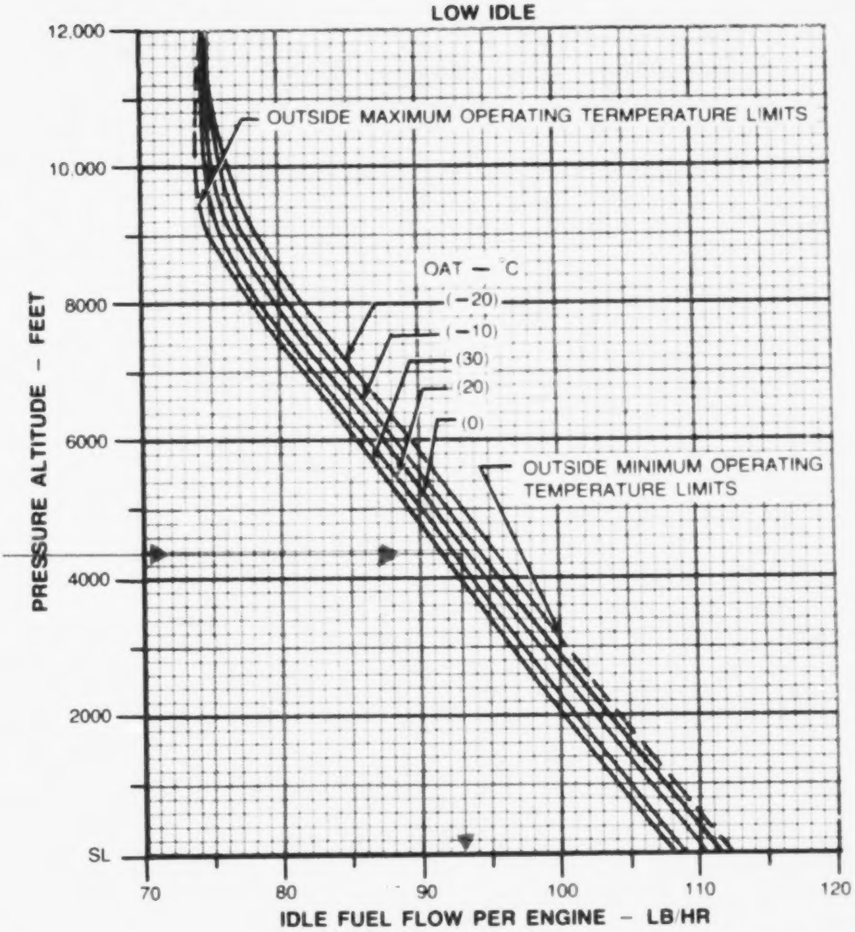
IDLE FUEL FLOW AT LOW IDLE

KNOWN

PRESSURE ALTITUDE = 4307 FT
FAT = 12°C

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO FAT = 12°C
MOVE DOWN, READ IDLE FUEL
FLOW = 93 LB/HR



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AP 001343

Figure 7-9. Idle Fuel Flow

Section V. TORQUE AVAILABLE FOR TAKEOFF

7-25. Description.

The torque available for Takeoff Chart (fig. 7-10) shows the torque in foot-pounds available for takeoff. The torque limits to observe for takeoff are also shown.

7-26. Use of chart.

Takeoff distances scheduled on the Takeoff-Normal Chart (fig. 7-11 or 7-12) are based on power set according to this chart.

7-27. Conditions.

a. Power levers – Advance to takeoff power.

b. Propeller speed – 2200 RPM.

TORQUE AVAILABLE FOR TAKEOFF
PROP SPEED = 2200 RPM
FUEL JP-4 AIRSPEED = 0 KNOTS

TORQUE AVAILABLE
FOR TAKEOFF
RU-21A, RU-21D
T74-CP-700

EXAMPLE

WANTED

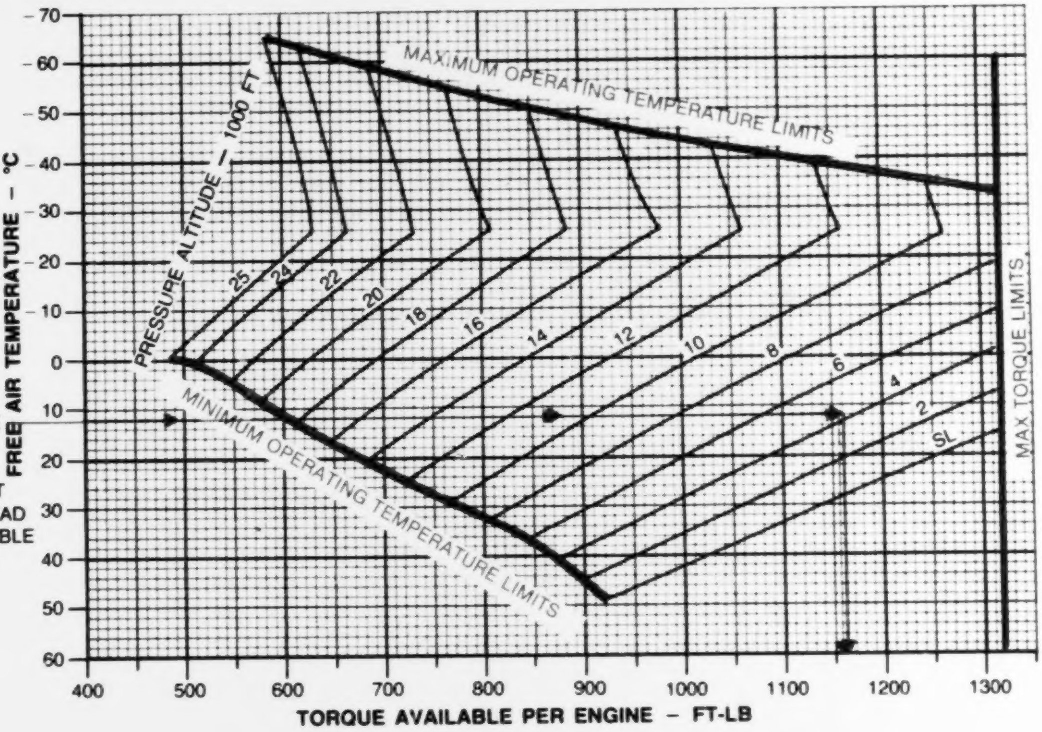
TORQUE AVAILABLE
FOR TAKEOFF

KNOWN

FAT = 12°C
PRESSURE
ALTITUDE =
4307 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO
PRESSURE ALT-
ITUDE = 4307 FT
MOVE DOWN, READ
TORQUE AVAILABLE
PER ENGINE =
1159 FT-LB



NOTE

1. TORQUE INCREASES APPROXIMATELY 15 FT-LB FROM ZERO TO 70 KNOTS.
2. THIS CHART IS BASED ON AN ENGINE WITH MAXIMUM DETERIORATION OF EXCESS TORQUE WHICH CAN BE PERMITTED WITHOUT EXCEEDING ENGINE LIMITATIONS.
3. TAKEOFF PERFORMANCE WAS DEVELOPED UTILIZING THE TORQUE VALUES SHOWN

DATA BASIS: CALCULATED FROM ENGINE MODEL SPEC.

AP 001344

Figure 7-10. Torque Available for Takeoff

Section VI. NORMAL TAKEOFF

7-28. Description. RU-21A

The Takeoff-Normal Chart (fig. 7-11), shows the ground roll distance and the total distance required to clear varying obstacle heights at a known free air temperature, pressure altitude and weight.

7-29. Use of chart. RU-21A

In order to achieve these distances, airspeeds obtained from the Normal Rotation/Takeoff Airspeed Chart (fig. 7-13), and power set according to the Torque Available for Takeoff Chart (fig. 7-10), shall be used.

7-30. Conditions. RU-21A

a. Engines – Both engines operating with takeoff power and 2200 RPM with torque set according to the Torque Available for Takeoff Chart (fig. 7-10).

b. Flaps – UP.

c. Landing gear – UP (after liftoff).

d. Technique – Apply maximum allowable takeoff power and accelerate on the runway. Takeoff power must be applied prior to releasing brakes to obtain the normal takeoff distances in chapter 7. Rotate at recommended rotation speed (V_r), establish a pitch attitude that allows liftoff at recommended liftoff speed (V_{lof}). When flight is assured, retract the gear and establish proper initial climb attitude (obstruction clearance climb speed V_x) or (best rate of climb speed V_y) dependent on existing conditions.

e. Wind – All data presented are based on calm wind conditions. Since surface wind speed and direction can not be accurately predicted, all takeoffs shall be planned based on calm wind. Distance decreases approximately 1% per knot headwind. Distance increases approximately 3% per knot tailwind.

f. Runway – Runway conditions for this chart are based on a dry, hard-surface, level runway. Conditions other than these will vary aircraft takeoff distances. Ground roll distance decreases approximately 5% per 1% downhill gradient. Ground roll distance increases approximately 7% per 1% uphill gradient.

NOTE

Refer to the Single-Engine Climb Chart (fig. 7-21), to determine if adequate performance is available in the event of engine failure during takeoff.

TAKEOFF – NORMAL

CALM WINDS FLAPS 0 PERCENT POWER - TAKEOFF
LEVEL HARD SURFACE

TAKEOFF – NORMAL
RU-21A
T74-CP-700

EXAMPLE

WANTED

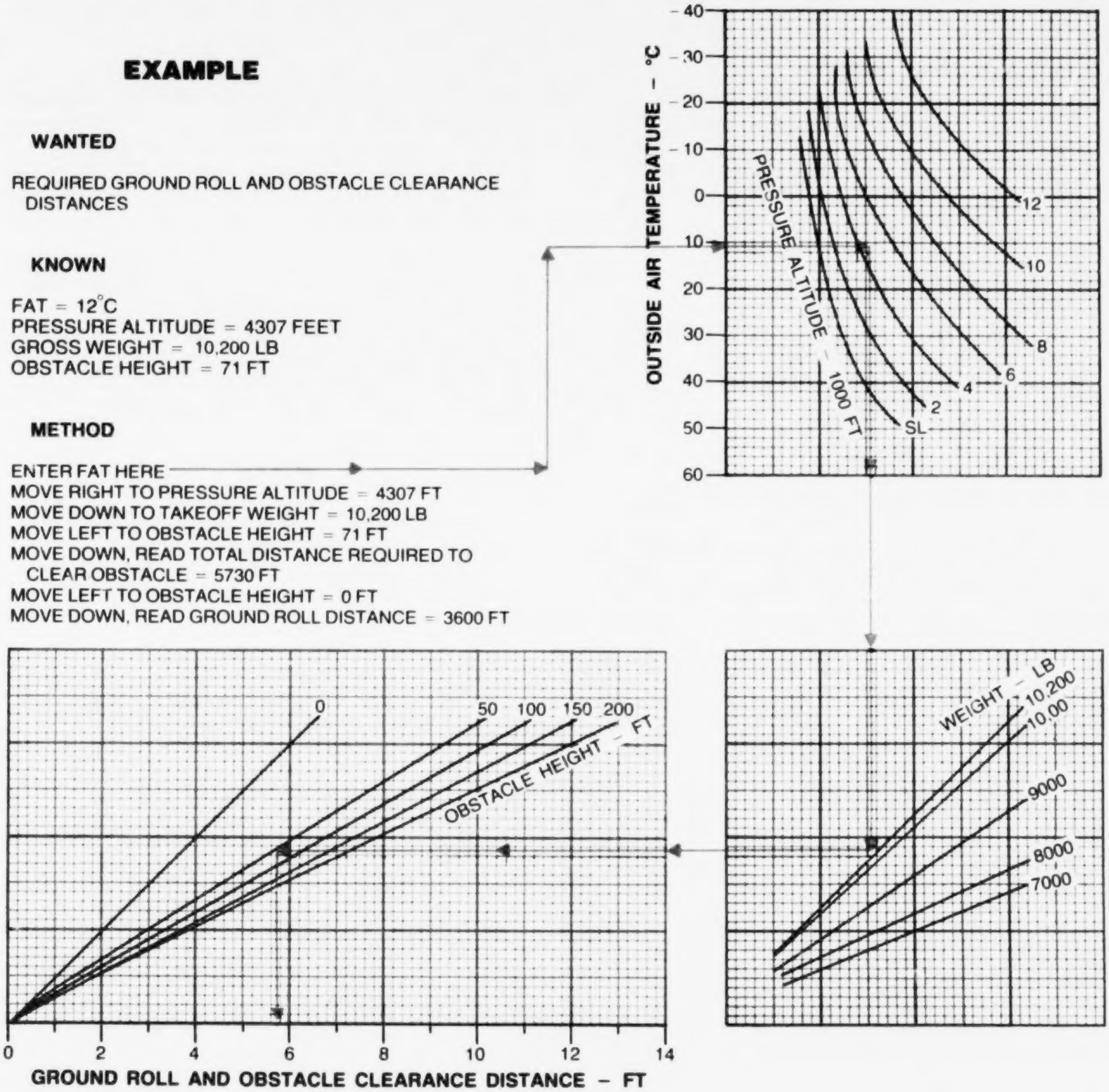
REQUIRED GROUND ROLL AND OBSTACLE CLEARANCE DISTANCES

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FEET
GROSS WEIGHT = 10,200 LB
OBSTACLE HEIGHT = 71 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT
MOVE DOWN TO TAKEOFF WEIGHT = 10,200 LB
MOVE LEFT TO OBSTACLE HEIGHT = 71 FT
MOVE DOWN, READ TOTAL DISTANCE REQUIRED TO CLEAR OBSTACLE = 5730 FT
MOVE LEFT TO OBSTACLE HEIGHT = 0 FT
MOVE DOWN, READ GROUND ROLL DISTANCE = 3600 FT



DATA BASIS: ESTIMATED

Figure 7-11. Takeoff - Normal RU-21A

7-31. Description. RU-21D

The Takeoff-Normal Chart (fig. 7-12), shows the ground roll distance and the total distance required to clear varying obstacle heights at a known free air temperature, pressure altitude and weight.

7-32. Use of chart. RU-21D

In order to achieve these distances, airspeeds obtained from the Normal Rotation/Takeoff Airspeed Chart (fig. 7-14), and power set according to the Torque Available for Takeoff Chart (fig. 7-10), shall be used.

7-33. Conditions. RU-21D

a. Engines – Both engines operating with takeoff power and 2200 RPM with fuel flow set according to the Torque Available for Takeoff Chart (fig. 7-10).

b. Flaps – UP.

c. Landing gear – UP (after liftoff).

d. Technique – Apply maximum allowable takeoff power and accelerate on the runway. Takeoff power must be applied prior to releasing brakes to obtain the normal takeoff distances in chapter 7. Rotate at recommended rotation speed (V_r), establish a pitch attitude that allows liftoff at recommended liftoff speed (V_{lof}). When flight is assured, retract the gear and establish proper initial climb attitude (obstruction clearance climb speed V_x) or (best rate of climb speed V_y) dependent on existing conditions.

e. Wind – All data presented are based on calm wind conditions. Since surface wind speed and direction can not be accurately predicted, all takeoffs shall be planned based on calm wind. Distance decreases approximately 1% per knot headwind. Distance increases approximately 3% per knot tailwind.

f. Runway – Runway conditions for this chart are based on a dry, hard-surface, level runway. Conditions other than these will vary aircraft takeoff distances. Ground roll distance decreases approximately 5% per 1% downhill gradient. Ground roll distance increases approximately 7% per 1% uphill gradient.

NOTE

Refer to the Single-Engine Climb Chart (fig. 7-22), to determine if adequate performance is available in the event of engine failure during takeoff.

TAKEOFF – NORMAL

CALM WINDS FLAPS 0 DEGREES POWER – TAKEOFF
LEVEL HARD SURFACE

TAKEOFF
NORMAL
RU-21D
T74-CP-700

EXAMPLE

WANTED

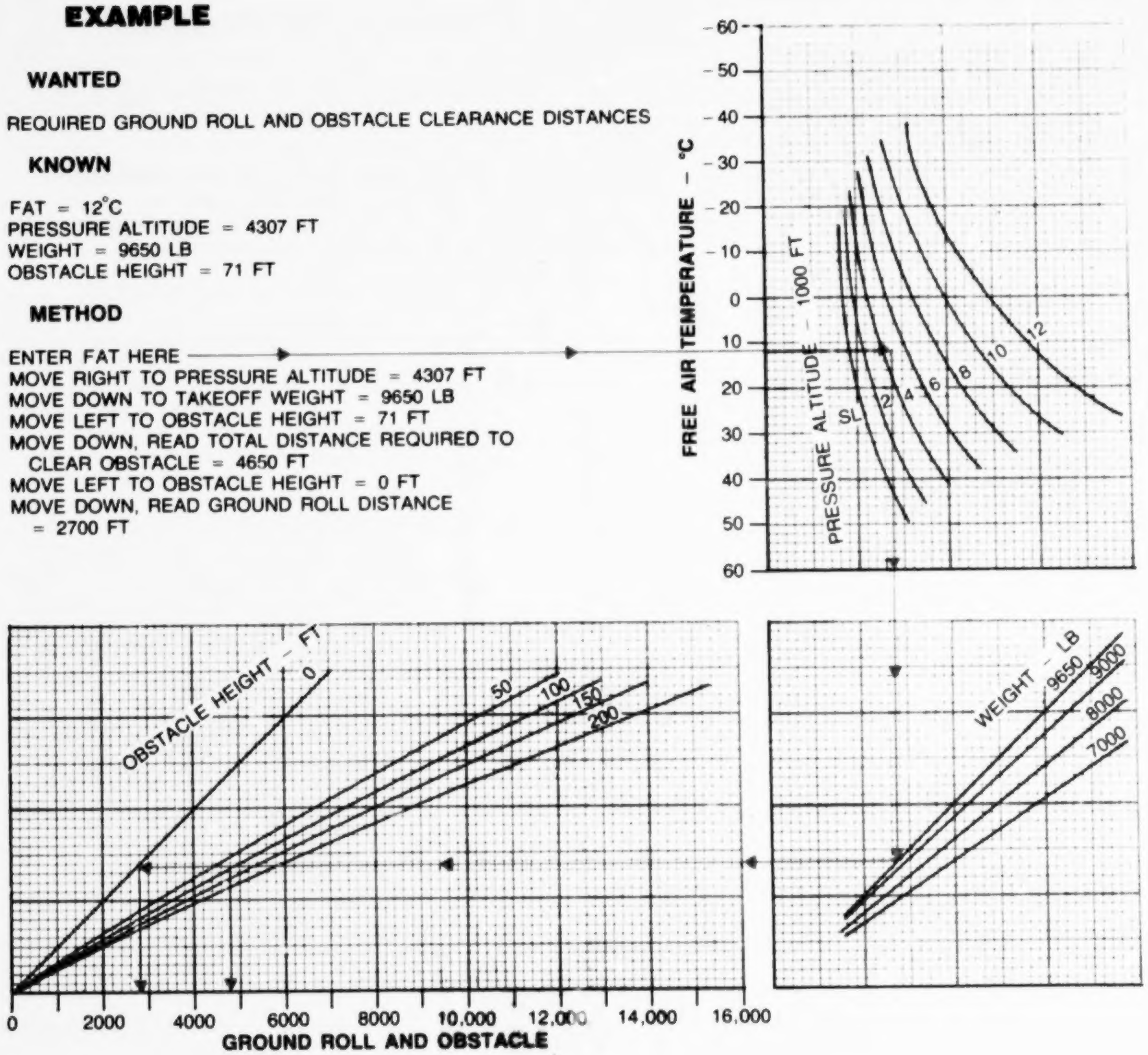
REQUIRED GROUND ROLL AND OBSTACLE CLEARANCE DISTANCES

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT
WEIGHT = 9650 LB
OBSTACLE HEIGHT = 71 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT
MOVE DOWN TO TAKEOFF WEIGHT = 9650 LB
MOVE LEFT TO OBSTACLE HEIGHT = 71 FT
MOVE DOWN, READ TOTAL DISTANCE REQUIRED TO CLEAR OBSTACLE = 4650 FT
MOVE LEFT TO OBSTACLE HEIGHT = 0 FT
MOVE DOWN, READ GROUND ROLL DISTANCE = 2700 FT



DATA BASIS: CALCULATED

AP 001385

Figure 7-12. Takeoff - Normal RU-21D

Section VII. NORMAL ROTATION/TAKEOFF AIRSPEED

7-34. Description. RU-21A

The Normal Rotation/Takeoff Airspeed Chart (fig. 7-13), shows rotation, takeoff, and obstacle clearance airspeeds for a known weight.

7-35. Use of Chart. RU-21A

The rotation airspeed line shows recommended rotation indicated airspeed for a given weight. The takeoff airspeed line shows recommended takeoff indicated airspeed for a given weight. The obstacle clearance airspeed line shows the recommended indicated airspeed for a given weight to use for clearance of obstacles during the initial climb. Performance scheduled on the Takeoff-Normal Chart, (fig. 7-11), is based on use of these speeds.

7-36. Conditions - Flaps UP. RU-21A

NOTE

These speeds have been selected in order to provide adequate margins above the flaps up stall speed and single-engine minimum control airspeed (Vmc).

NORMAL ROTATION/TAKEOFF AIRSPEED

FLAPS 0 PERCENT

NORMAL ROTATION
TAKEOFF AIRSPEED
RU-21A
T74-CP-700

EXAMPLE

WANTED

NORMAL ROTATION, TAKEOFF AND OBSTACLE CLEARANCE AIRSPEED FOR KNOWN GROSS WEIGHTS

KNOWN

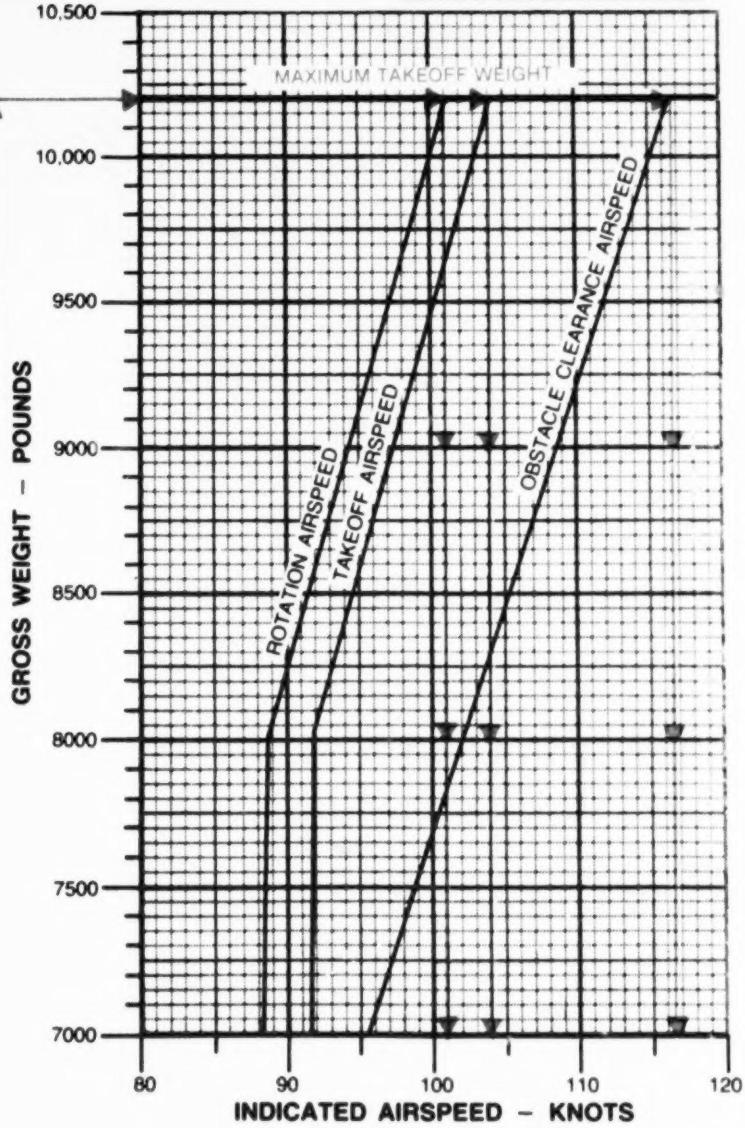
GROSS WEIGHT = 10,200 LB

METHOD

ENTER GROSS WEIGHT HERE
MOVE RIGHT TO ROTATION SPEED, TAKEOFF AIRSPEED AND OBSTACLE CLEARANCE AIRSPEED LINES
MOVE DOWN FROM ROTATION AIRSPEED LINE, READ INDICATED AIRSPEED FOR ROTATION = 101 KT
MOVE DOWN FROM TAKEOFF AIRSPEED LINE, READ INDICATED AIRSPEED FOR TAKE OFF = 104 KT
MOVE DOWN FROM OBSTACLE CLEARANCE AIRSPEED LINE, READ INDICATED AIRSPEED FOR OBSTACLE CLEARANCE = 116.6 KT

NOTE

OBSTACLE CLEARANCE AIRSPEED LINE ALSO INDICATES THE BEST TWO AND SINGLE-ENGINE ANGLE OF CLIMB ENGINE SPEEDS.



DATA BASIS: ESTIMATED

Figure 7-13. Normal Rotation/Takeoff Airspeed **RU-21A**

7-37. Description. RU-21D

The Normal Rotation/Takeoff Airspeed Char (fig. 7-14), shows rotation, takeoff, and obstacle clearance airspeeds for a known weight.

7-38. Use of Chart. RU-21D

The rotation airspeed line shows recommended rotation indicated airspeed for a given weight. The takeoff airspeed line shows recommended takeoff indicated airspeed for a given weight. The obstacle clearance airspeed line shows the recommended indicated airspeed for a given weight to use for clearance of obstacles during the initial climb. Performance scheduled on the Takeoff-Normal Chart, (fig. 7-12), is based on use of these speeds.

7-39. Conditions - Flaps UP. RU-21D

NOTE

These speeds have been selected in order to provide adequate margins above the flaps up stall speed and single-engine minimum control airspeed (Vmc).

NORMAL ROTATION/TAKEOFF AIRSPEED

FLAPS 0 PERCENT

NORMAL ROTATION/ TAKEOFF AIRSPEED
RU-21D
T74-CP-700

EXAMPLE

WANTED

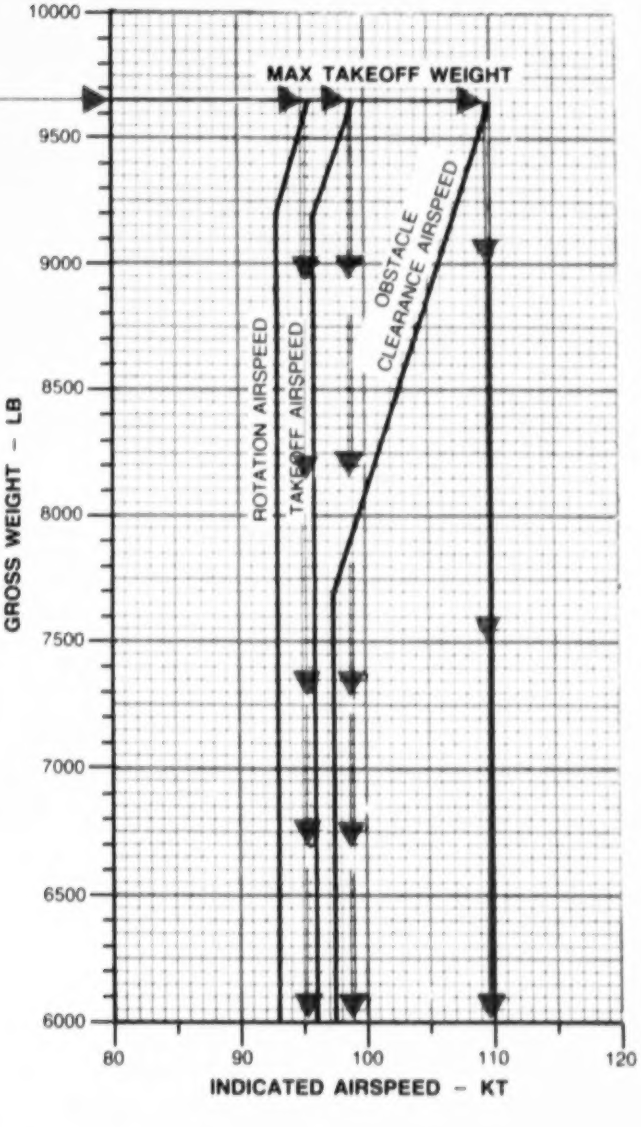
NORMAL ROTATION, TAKEOFF, AND OBSTACLE CLEARANCE AIRSPEEDS FOR KNOWN TAKEOFF WEIGHT

KNOWN

TAKEOFF WEIGHT = 9650 LB

METHOD

ENTER TAKEOFF WEIGHT HERE
MOVE RIGHT TO ROTATION AIRSPEED, TAKEOFF AIRSPEED AND OBSTACLE CLEARANCE AIRSPEED LINES
MOVE DOWN FROM ROTATION AIRSPEED LINE, READ INDICATED AIRSPEED FOR ROTATION 96 KT
MOVE DOWN FROM TAKEOFF AIRSPEED LINE, READ INDICATED AIRSPEED FOR TAKEOFF 99 KT
MOVE DOWN FROM OBSTACLE CLEARANCE AIRSPEED LINE, READ INDICATED AIRSPEED FOR OBSTACLE CLEARANCE 110 KT



DATA BASIS: FLIGHT TEST

AP 000984

Figure 7-14. Normal Rotation/Takeoff Airspeed **RU-21D**

Section VIII. ACCELERATION CHECK

7-40. Description. RU-21A

The Acceleration Check Chart (fig. 7-15), shows the relationship between indicated airspeed and ground roll distance during the takeoff run.

7-41. Use of Chart. RU-21A

Required airspeeds at designated points along the runway are obtained from this chart. This chart is used in conjunction with the ground roll distance from the Takeoff-Normal Chart (fig. 7-11), and the takeoff airspeed from the Normal Rotation/Takeoff Airspeed Chart (fig. 7-13). If required indicated airspeed is not obtained at a selected distance and the runway length is critical, the takeoff should be aborted.

7-42. Conditions. RU-21A

a. Engines – Both engines operating with takeoff power and 2200 RPM according to Torque Available for Takeoff Chart (fig. 7-10).

b. Flaps – UP.

c. Landing gear – DN.

d. Technique – Apply takeoff power and accelerate on the runway. When the aircraft passes an acceleration check point, insure that the required airspeed has been achieved.

e. Runway – This chart is based on a dry, hard surface runway. Conditions other than this may vary aircraft operation. Adjust ground roll distance for runway gradient before entering this chart. Refer to Takeoff-Normal Chart (fig. 7-11).

f. Wind – All data presented is based on calm wind conditions. Since surface wind conditions cannot be accurately predicted, all takeoffs shall be planned based on calm wind.

NOTE

This chart should always be entered with the takeoff airspeed appropriate to the weight.

g. Acceleration Check – Is the distance from start of takeoff ground roll to an acceleration check point (runway distance marker, etc.)

ACCELERATION CHECK

POWER – TAKEOFF CALM WINDS FLAPS 0 PERCENT
LEVEL HARD SURFACE

ACCELERATION CHECK
RU-21A
T74-CP-700

EXAMPLE

WANTED

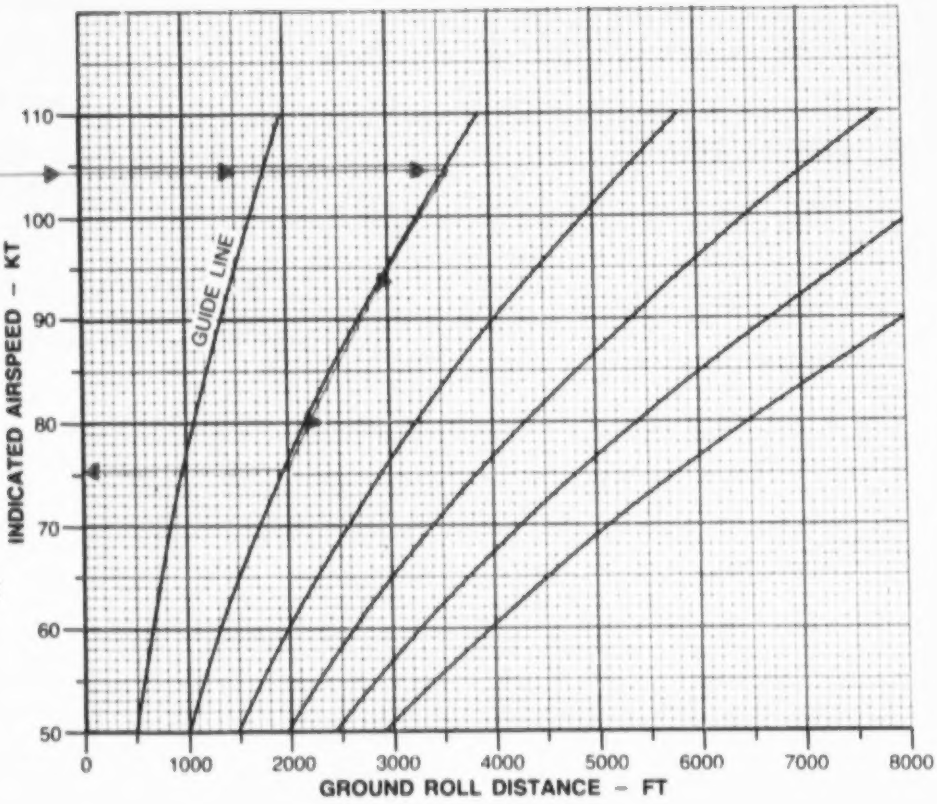
AIRSPEED REQUIRED AT VARIOUS ACCELERATION CHECK POINTS

KNOWN

TAKEOFF AIRSPEED FOR KNOWN GROSS WEIGHT OF 10,200 LB = 104 KT
GROUND ROLL DISTANCE = 3600 FT

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO GROUND ROLL DISTANCE LINE = 3600 FT
MOVE DOWN FOLLOWING THE GUIDELINES TO THE 2000 FT GROUND ROLL DISTANCE LINE
MOVE LEFT READ INDICATED AIRSPEED REQUIRED AT 2000 FT MARKER = 75 KT



DATA BASIS: ESTIMATED

AP 000793

Figure 7-15. Acceleration Check RU-21A

7-43. Description. RU-21D

The Acceleration Check Chart (fig. 7-16), shows the relationship between indicated airspeed and ground roll distance during the takeoff run.

7-44. Use of Chart. RU-21D

Required airspeeds at designated points along the runway are obtained from this chart. This chart is used in conjunction with the ground roll distance from the Takeoff-Normal Chart (fig. 7-12), and the takeoff airspeed from the Normal Rotation/Takeoff Airspeed Chart (fig. 7-14). If required indicated airspeed is not obtained at a selected distance the runway length is critical, the takeoff should be aborted.

7-45. Conditions. RU-21D

a. Engines – Both engines operating with takeoff power and 2200 RPM according to Torque Available for Takeoff Chart (fig. 7-10).

b. Flaps – UP.

c. Landing gear – DN.

d. Technique – Apply takeoff power and accelerate on the runway. When the aircraft passes an acceleration check point, insure that the required airspeed has been achieved.

e. Runway – This chart is based on a dry, hard surface runway. Conditions other than this may vary aircraft operation. Adjust ground roll distance for runway gradient before entering this chart. Refer to Takeoff-Normal Chart (fig. 7-12).

f. Wind – All data presented is based on calm wind conditions. Since surface wind conditions cannot be accurately predicted, all takeoffs shall be planned based on calm wind.

NOTE

This chart should always be entered with the takeoff airspeed appropriate to the weight.

g. Acceleration Check – Is the distance from start of takeoff ground roll to an acceleration check point (runway distance marker, etc.)

ACCELERATION CHECK

POWER – TAKEOFF CALM WINDS
FLAPS 0 PERCENT LEVEL HARD SURFACE

ACCELERATION CHECK
RU-21D
T74-CP-700

EXAMPLE

WANTED

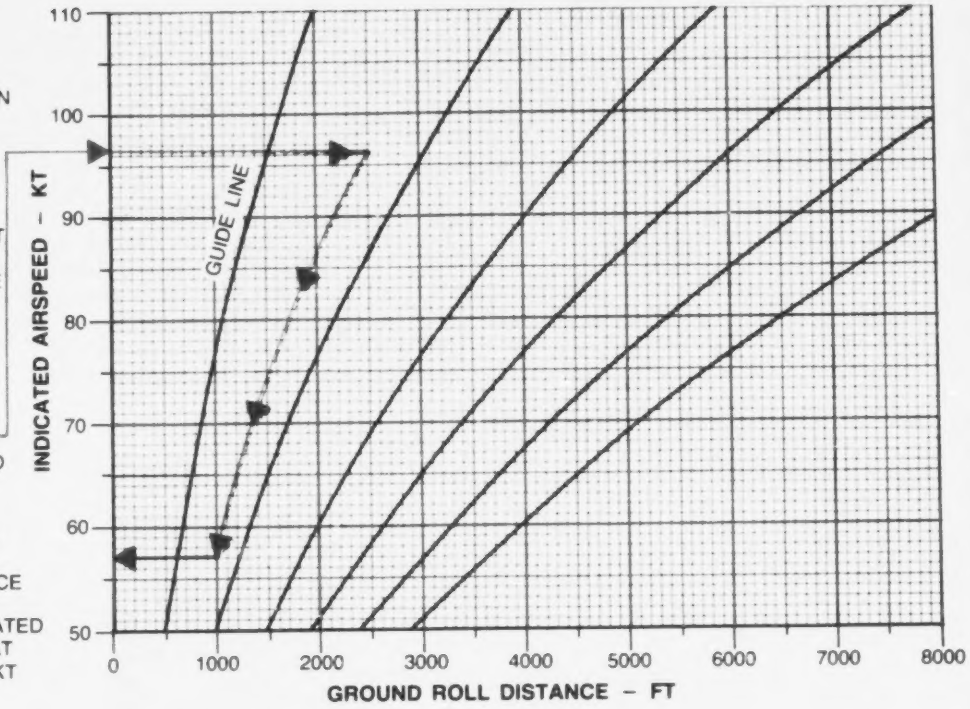
AIRSPEED REQUIRED AT VARIOUS ACCELERATION CHECK POINTS

KNOWN

TAKEOFF AIRSPEED FOR KNOWN GROSS WEIGHT OF 9,650 LB = 96 KT
GROUND ROLL DISTANCE = 2500 FT

METHOD

ENTER INDICATED AIR SPEED HERE
MOVE RIGHT TO GROUND ROLL DISTANCE LINE = 2500 FT
MOVE DOWN THE GUIDE LINE TO THE 1000 FT GROUND ROLL DISTANCE LINE
MOVE LEFT, READ INDICATED AIRSPEED REQUIRED AT 1000 FT MARKER = 57 KT



DATA BASIS: ESTIMATED

AP 001539

Figure 7-16. Acceleration Check RU-21D

Section IX. ACCELERATE - STOP DISTANCE

7-46. Description. RU-21A

The Accelerate-Stop Distance Chart (fig. 7-17) shows the distance required to accelerate to takeoff airspeed then stop, at a known free air temperature, pressure altitude, and weight.

7-47. Use of Chart. RU-21A

In order to achieve these distances, takeoff airspeeds obtained from the Normal Rotation/Takeoff Airspeed Chart (fig. 7-13), and power set according to the Torque Available for Takeoff Chart (fig. 7-10), shall be assumed.

7-48. Conditions. RU-21A

a. Engines – Both engines operating with takeoff power and 2200 RPM with torque set according to the Torque Available for Takeoff Chart (fig. 7-10).

b. Flaps – Up.

c. Technique – Apply takeoff power prior to releasing brakes. Should engine failure occur at or before reaching takeoff airspeed, place both power levers in the idle position and apply maximum braking.

d. Wind – All data presented are based on calm wind conditions. Since surface wind speed and direction can not be accurately predicted, all takeoffs shall be planned based on calm wind. Accelerate stop distances decrease approximately 1% per knot headwind and increase approximately 3% per knot tailwind.

e. Runway – Runway conditions for this chart are based on a dry, hard surface, level runway. Conditions other than these will vary aircraft accelerate-stop distances. Accelerate-stop distances increase approximately 4% per 1% downhill gradient. Accelerate-stop distances decrease approximately 3% per 1% uphill gradient.

ACCELERATE-STOP
RU-21A
T74-CP-700

ACCELERATE-STOP DISTANCE
CALM WINDS FLAPS 0 PERCENT POWER – TAKE-OFF LEVEL HARD SURFACE

EXAMPLE

WANTED

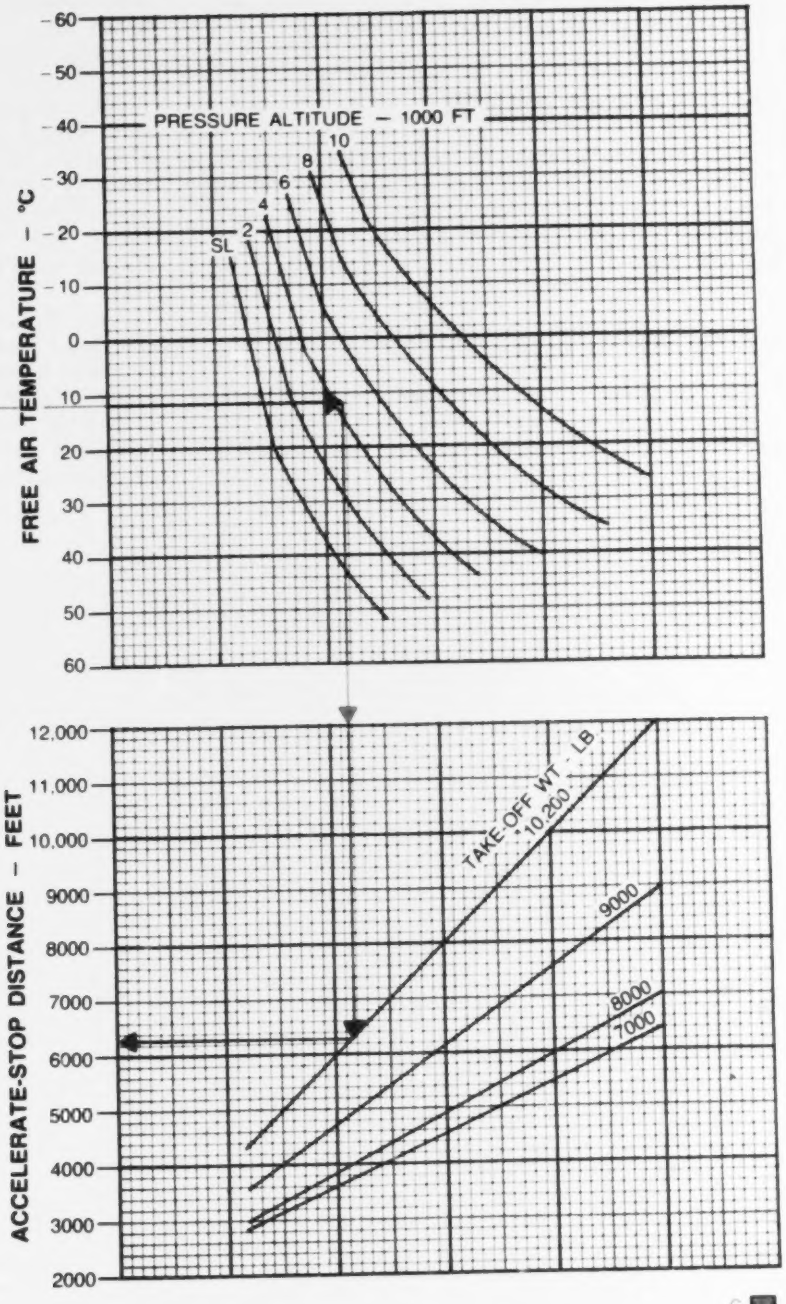
DISTANCE REQUIRED TO ACCELERATE TO TAKE-OFF AIRSPEED, THEN STOP

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT
TAKE-OFF WEIGHT = 10,200 LB

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT
MOVE DOWN TO TAKE-OFF WEIGHT = 10,200 LB
MOVE LEFT TO ACCELERATE-STOP DIST. = 6250 FT



DATA BASIS: ESTIMATED

Figure 7-17. Accelerate - Stop Distance **RU-21A**

7-49. Description. RU-21D

The Accelerate-Stop Distance Chart (fig. 7-18) shows the distance required to accelerate to takeoff airspeed then stop, at a known free air temperature, pressure altitude, and weight.

7-50. Use of Chart. RU-21D

In order to achieve these distances, takeoff airspeeds obtained from the Normal Rotation/Takeoff Airspeed Chart (fig. 7-14), and power set according to the Torque Available for Takeoff Chart (fig. 7-10), shall be assumed.

7-51. Conditions. RU-21D

a. Engines – Both engines operating with takeoff power and 2200 RPM with torque set according to the Torque Available for Takeoff Chart (fig. 7-10).

b. Flaps – Up.

c. Technique – Apply takeoff power prior to releasing brakes. Should engine failure occur at or before reaching takeoff airspeed, place both power levers in the idle position and apply maximum braking.

d. Wind – All data presented are based on calm wind conditions. Since surface wind speed and direction can not be accurately predicted, all takeoffs shall be planned based on calm wind. Accelerate stop distances decrease approximately 1% per knot headwind and increase approximately 3% per knot tailwind.

e. Runway – Runway conditions for this chart are based on a dry, hard surface, level runway. Conditions other than these will vary aircraft accelerate-stop distances. Accelerate-stop distances increase approximately 4% per 1% downhill gradient. Accelerate-stop distances decrease approximately 3% per 1% uphill gradient.

ACCELERATE-STOP DISTANCE

CALM WINDS FLAPS 0 PERCENT POWER – TAKEOFF
LEVEL HARD SURFACE

ACCELERATE-STOP
RU-21D
T74-CP-700

EXAMPLE

WANTED

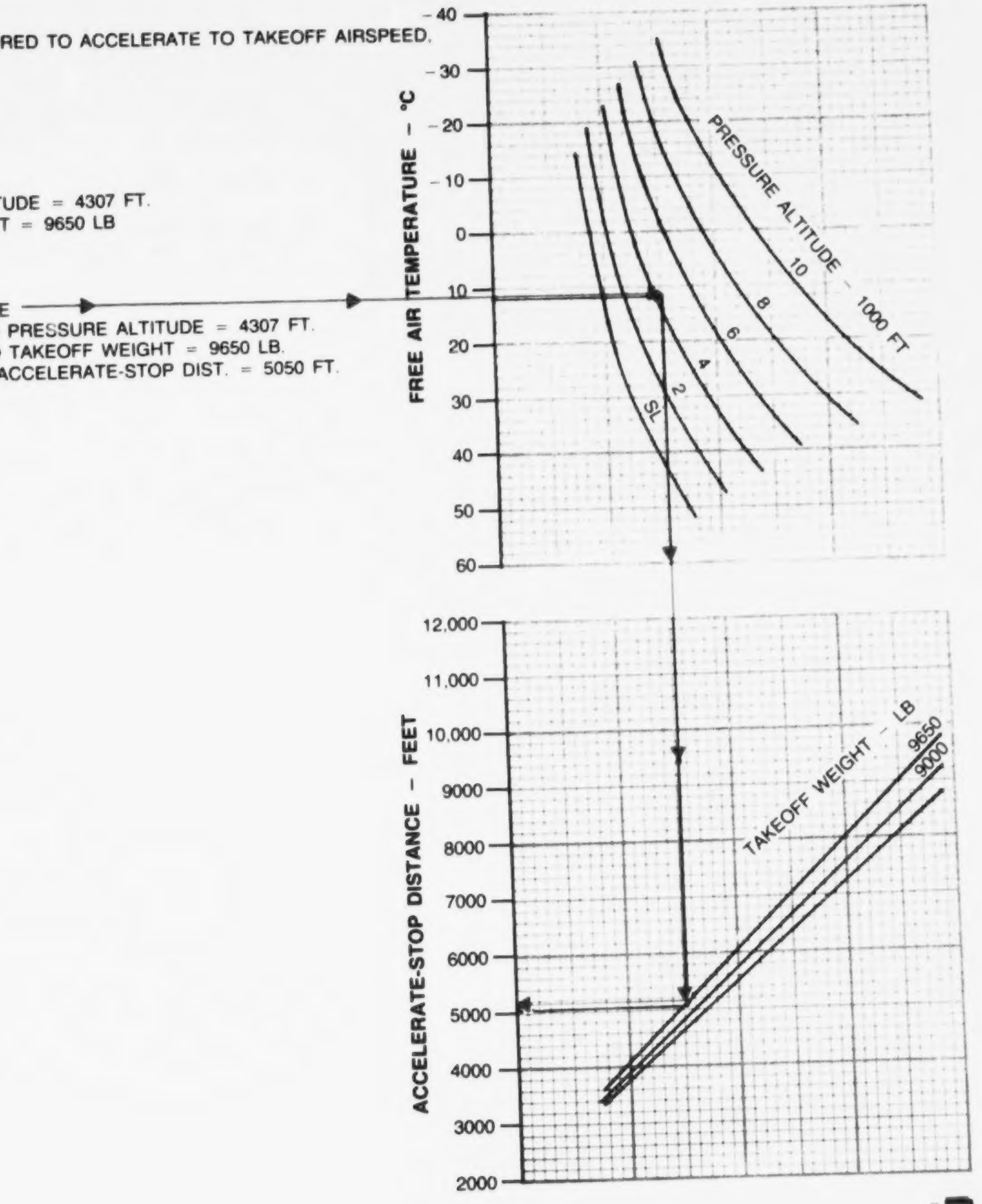
DISTANCE REQUIRED TO ACCELERATE TO TAKEOFF AIRSPEED, THEN STOP

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT.
TAKEOFF WEIGHT = 9650 LB

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT.
MOVE DOWN TO TAKEOFF WEIGHT = 9650 LB.
MOVE LEFT TO ACCELERATE-STOP DIST. = 5050 FT.



AP 003224

DATA BASIS: ESTIMATED

Figure 7-18. Accelerate - Stop Distance RU-21D

Section X. MINIMUM SINGLE ENGINE CONTROL AIRSPEED

7-52. Description. RU-21A

The Minimum Single-Engine Control Airspeed Chart (fig. 7-19), shows the minimum airspeed (Vmc) which will allow aircraft directional control during single-engine operation for various air temperatures and altitudes. Directional control of the aircraft cannot be maintained for speeds below the rudder limit line with the non critical engine operating at takeoff power.

7-53. Use of Chart. RU-21A

Flight at Vmc implies aircraft directional control only and does not provide the pilot with single-engine rate of climb information.

7-54. Conditions. RU-21A

a. Operating Engine – Operate with takeoff power and 2200 RPM according to the Torque Available for Takeoff Chart (fig. 7-10).

b. Inoperative engine – Propeller FEATHER.

c. Flaps – UP.

d. Landing Gear – DN.

MINIMUM SINGLE ENGINE
CONTROL AIRSPEED
RU-21A
T74-CP-700

MINIMUM SINGLE ENGINE CONTROL AIRSPEED (Vmc)

POWER-TAKEOFF GEAR DOWN FLAPS 0 PERCENT PROPELLER FEATHERED

EXAMPLE

WANTED

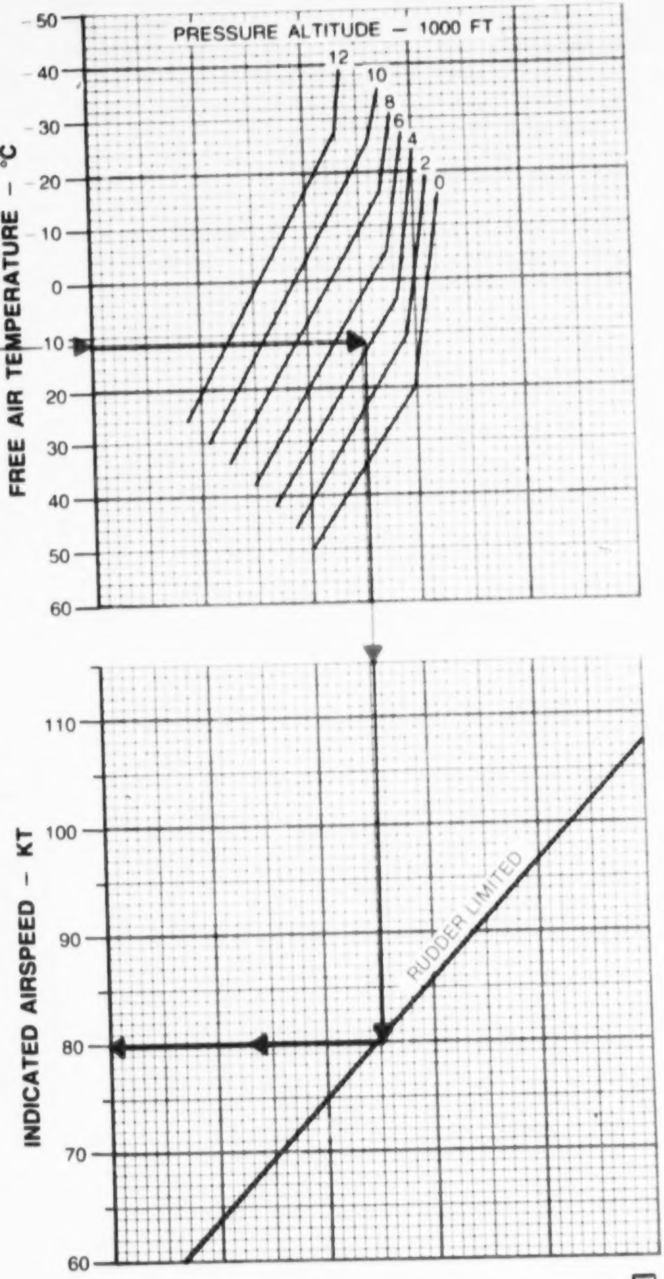
MINIMUM SINGLE ENGINE CONTROL AIR SPEED AT A GIVEN FAT AND PRESSURE ALTITUDE

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT
MOVE DOWN TO RUDDER LIMITED LINE
MOVE LEFT, READ MINIMUM CONTROL INDICATED AIRSPEED = 80 KT



NOTE

AT SOME WEIGHTS, A STALL CONDITION CAN OCCUR AT AIRSPEEDS HIGHER THAN THE RUDDER LIMITED Vmc.

AP 001348

DATA BASIS: FLIGHT TEST

Figure 7-19. Minimum Single-Engine Control Airspeed **RU-21A**

7-55. Description. RU-21D

The Minimum Single-Engine Control Airspeed Chart (fig. 7-20), shows the minimum airspeed (Vmc) which will allow aircraft directional control during single-engine operation for various air temperatures and altitudes. Directional control of the aircraft cannot be maintained for speeds below the rudder limit line with the non critical engine operating at takeoff power.

7-56. Use of Chart. RU-21D

Flight at Vmc implies aircraft control only and does not provide the pilot with single-engine rate-of-climb information.

7-57. Conditions. RU-21D

a. Operating Engine – Operate with takeoff power and 2200 RPM according to the Torque Available for Takeoff Chart (fig. 7-10).

b. Inoperative engine – Propeller FEATHER.

c. Flaps – UP.

d. Landing Gear – DN.

MINIMUM SINGLE ENGINE CONTROL AIRSPEED (Vmc)

POWER – TAKEOFF GEAR DOWN
FLAPS 0 PERCENT PROP FEATHERED

MINIMUM SINGLE ENGINE
CONTROL AIRSPEED
RU-21D
T74-CP-700

EXAMPLE

WANTED

MINIMUM SINGLE ENGINE CONTROL AIRSPEED AT A GIVEN FAT AND PRESSURE ALTITUDE

KNOWN

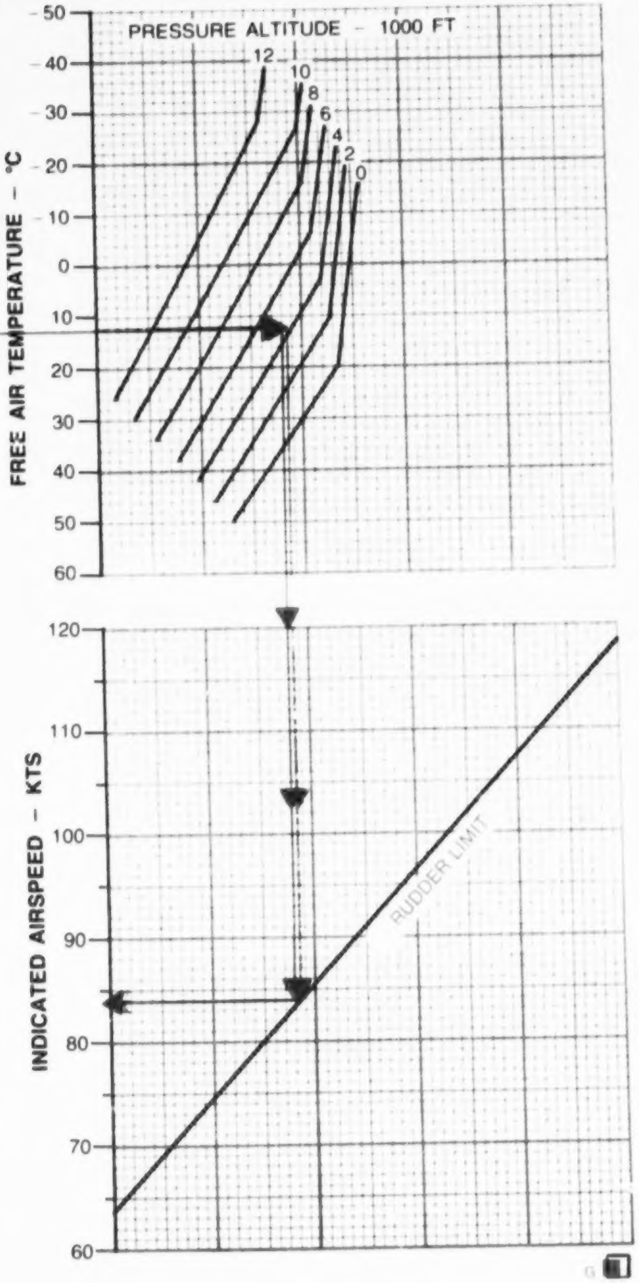
FAT = 12°C
PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT
MOVE DOWN TO RUDDER LIMITED LINE
MOVE LEFT. READ MINIMUM CONTROL INDICATED AIRSPEED = 84 KNOTS

NOTE

AT SOME WEIGHTS A STALL CONDITION CAN OCCUR AT AIRSPEEDS HIGHER THAN THE RUDDER LIMITED Vmc



AP 004559

DATA BASIS: FLIGHT TEST

Figure 7-20. Minimum Single-Engine Control Airspeed RU-21D

Section XI. SINGLE ENGINE CLIMB

7-58. Description. RU-21A

The Single-engine Climb Chart (fig. 7-21), shows the critical engine inoperative takeoff rate-of-climb for varying air temperatures, altitudes, and weights for the gear down and gear up configurations. For single-engine cruise information refer to the Cruise Charts (fig. 7-27 thru fig. 7-74), and for Vmc refer to the Minimum Single-Engine Control Speed Chart (fig. 7-19).

7-59. Use of Chart. RU-21A

This chart is to be used to determine single-engine performance in the event of engine failure during the takeoff and initial climb segments. Either weight for a desired rate-of-climb, or rate-of-climb for a known weight can be determined. Performance within the red zone(s) indicates the lack of positive climb capability.

7-60. Conditions. RU-21A

a. Operating Engine – Operate at takeoff power and 2200 RPM according to the Torque Available for Takeoff Chart (fig. 7-10).

b. Inoperative engine – Propeller FEATHER.

c. Flaps – UP.

d. Landing gear – UP (after liftoff).

e. Technique – Achieve and maintain the obstacle clearance airspeed appropriate to the weight. Refer to Normal Rotation/Takeoff Airspeed Chart (fig. 7-13).

NOTE

Refer to Normal Rotation/Takeoff Airspeed Chart (fig. 7-13). Gear down rates of climb are based on climb at the scheduled takeoff airspeed. Gear up rates of climb are based on climb at the scheduled obstacle clearance airspeed.

SINGLE ENGINE CLIMB
TAKEOFF CONFIGURATION

FLAPS 0 PERCENT PROPELLER FEATHERED POWER – TAKEOFF

SINGLE ENGINE CLIMB
RU-21A
T74-CP-700

EXAMPLE

WANTED

WEIGHT TO OBTAIN A POSITIVE SINGLE ENGINE R/C AT LIFTOFF AND SINGLE ENGINE R/C AFTER THE GEAR IS RETRACTED

KNOWN

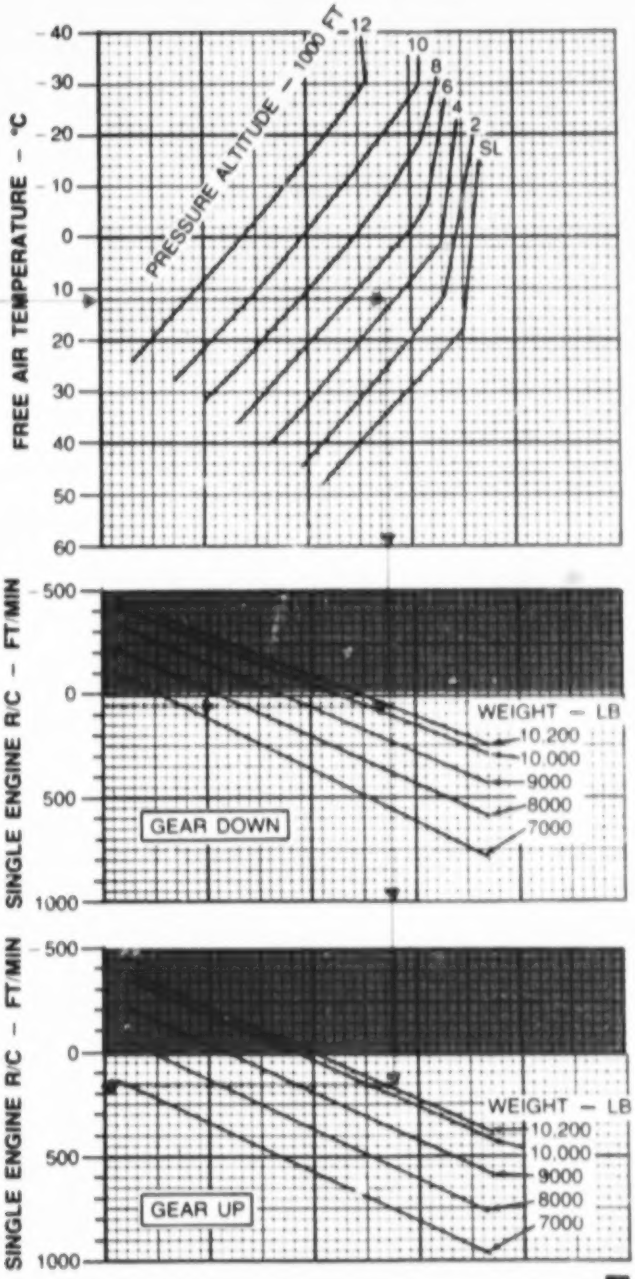
FAT = 12°C
PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER FAT HERE ——▶
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT
MOVE DOWN TO 0 FT/MIN R/C
FOR GEAR DOWN, READ WEIGHT TO OBTAIN POSITIVE R/C AT LIFTOFF = 10,200 LB
MOVE DOWN TO WEIGHT = 10,200 LB FOR GEAR UP CLIMB
MOVE LEFT, READ SINGLE ENGINE R/C AFTER GEAR RETRACTION = 175 FT/MIN

NOTE

NOT TO EXCEED MAXIMUM TAKEOFF WEIGHT



AP 001340

DATA BASIS: ESTIMATED

Figure 7-21. Single-Engine Climb RU-21A

7-61. Description. RU-21D

The Single-engine Climb Chart (fig. 7-22), shows the critical engine inoperative takeoff rate-of-climb for varying air temperatures, altitudes, and weights for the gear down and gear up configurations. For single-engine cruise information refer to the Cruise Charts (fig. 7-75 thru fig. 7-123), and for Vmc refer to the Minimum Single-Engine Control Speed Chart (fig. 7-20).

7-62. Use of Chart. RU-21D

This chart is to be used to determine single-engine performance in the event of engine failure during the takeoff and initial climb segments. Performance within the red zone(s) indicates the lack of positive climb capability.

7-63. Conditions. RU-21D

a. Operating Engine – Operate at takeoff power and 2200 RPM according to the Torque Available for Takeoff Chart (fig. 7-10).

b. Inoperative engine – Propeller FEATHER.

c. Flaps – UP.

d. Landing gear – UP (after liftoff).

e. Technique – Achieve and maintain the obstacle clearance airspeed appropriate to the weight. Refer to Normal Rotation/Takeoff Airspeed Chart (fig. 7-14).

NOTE

Refer to Normal Rotation/Takeoff Airspeed Chart (fig. 7-14). Gear down rates of climb are based on climb at the scheduled takeoff airspeed. Gear up rates of climb are based on climb at the scheduled obstacle clearance airspeed.

SINGLE ENGINE CLIMB
TAKEOFF CONFIGURATION

SINGLE-ENGINE CLIMB
RU-21D
T74-CP-700

FLAPS 0 PERCENT PROPELLER FEATHERED POWER – TAKEOFF

EXAMPLE

WANTED

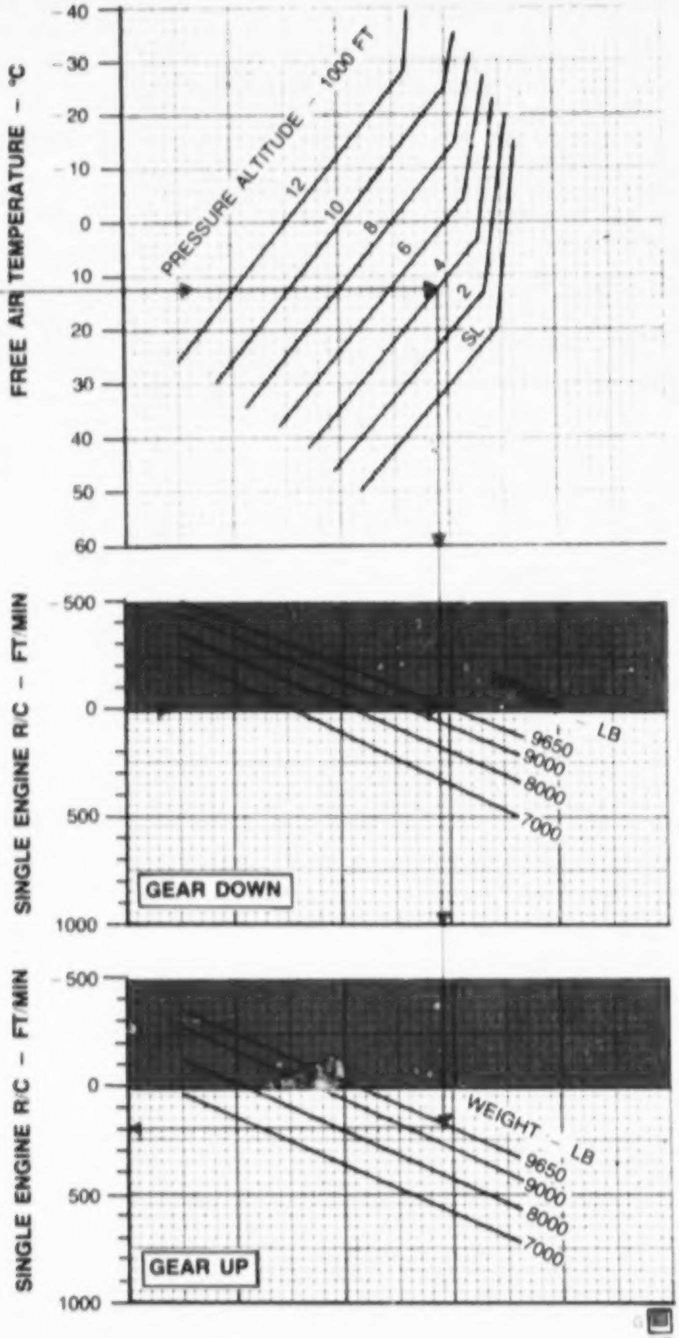
WEIGHT TO OBTAIN A POSITIVE SINGLE ENGINE R/C AT LIFTOFF AND SINGLE ENGINE R/C AFTER THE GEAR IS RETRACTED

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4307 FT
MOVE DOWN TO 0 FT/MIN R/C FOR GEAR DOWN, READ WEIGHT TO OBTAIN POSITIVE R/C AT LIFTOFF = 9650 LB
MOVE DOWN TO WEIGHT = 9650 LB FOR GEAR UP CLIMB
MOVE LEFT READ SINGLE ENGINE R/C AFTER GEAR RETRACTION = 175 FT/MIN



AP 001389

DATA BASIS: CALCULATED

Figure 7-22. Single-Engine Climb RU-21D

Section XII. OPERATION ENVELOPE

7-64. Description. RU-21A

The Operation Envelope Chart (fig. 7-23), shows the maximum temperatures for which operation is permitted; the minimum temperatures for which operation is recommended; the maximum altitudes possible for both two and single-engine operations; and identifies the altitude and temperature combinations for which Cruise Charts are available.

7-65. Use of Chart. RU-21A

This chart is used to determine if the proposed flight is within the operational temperature/altitude envelope and to identify the temperature and altitude combinations which should be used for flight planning.

7-66. Conditions. RU-21A

Service ceilings are based on the aircraft in a clean configuration.

OPERATION ENVELOPE

OPERATION ENVELOPE
RU-21A
T74-CP-700

EXAMPLE

WANTED

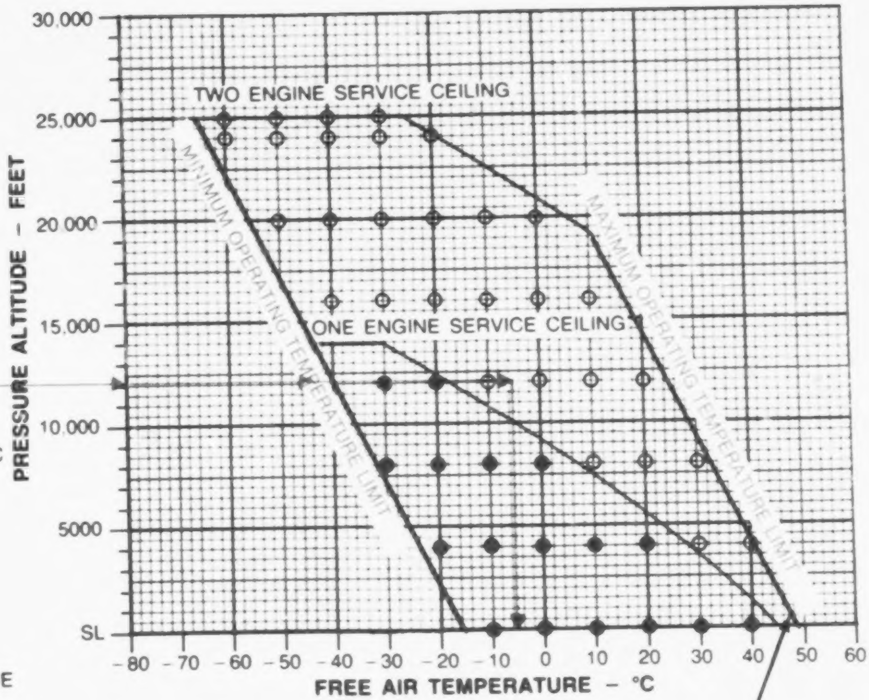
DETERMINE IF FLIGHT IS WITHIN THE OPERATION ENVELOPE
DETERMINE THE CRUISE CHARTS TO USE FOR PERFORMANCE PLANNING

KNOWN

PRESSURE ALTITUDE = 12,000 FT
FAT = -5°C

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO FAT = -5°C
OPERATION IS WITHIN ENVELOPE
USE CRUISE CHARTS FOR -10°C AND 0°C AT 12,000 FT



NOTE

CIRCLES DENOTE CONDITIONS WHERE CRUISE PERFORMANCE IS PRESENTED.
SHADED CIRCLES DENOTE CONDITIONS WHERE TWO ENGINE AND SINGLE ENGINE CRUISE PERFORMANCE ARE PRESENTED.

NO AIRCRAFT PERFORMANCE OR ENGINE OPERATING CHARACTERISTICS HAVE BEEN DEMONSTRATED ABOVE THE MAXIMUM OPERATING TEMPERATURE LIMIT.

AP 001350

DATA BASIS: ESTIMATED

Figure 7-23. Operation Envelope RU-21A

7-67. Description. RU-21D

The Operation Envelope Chart (fig. 7-24), shows the maximum temperatures for which operation is permitted; the minimum temperatures for which operation is recommended; the maximum altitudes possible for both two and single-engine operations; and identifies the altitude and temperature combinations for which Cruise Charts are available.

7-68. Use of Chart. RU-21D

This chart is used to determine if the proposed flight is within the operational temperature/altitude envelope and to identify the temperature and altitude combinations which should be used for flight planning.

7-69. Conditions. RU-21D

Service ceilings are based on the aircraft in a clean configuration.

OPERATION ENVELOPE

OPERATION ENVELOPE
RU-21D
T74-CP-700

EXAMPLE

WANTED

DETERMINE IF FLIGHT IS WITHIN THE OPERATION ENVELOPE

DETERMINE THE CRUISE CHARTS TO USE FOR PERFORMANCE PLANNING

KNOWN

PRESSURE ALTITUDE = 12,000 FT

FAT = −5°C

METHOD

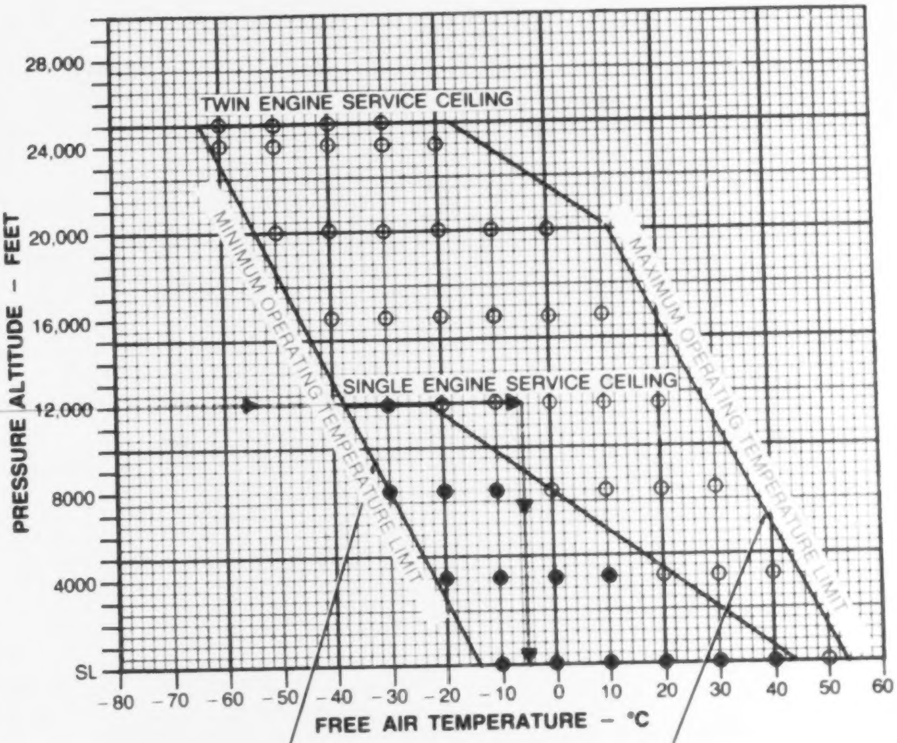
ENTER PRESSURE ALTITUDE HERE

MOVE RIGHT TO FAT. OPERATION IS WITHIN ENVELOPE

USE CRUISE CHARTS FOR 0°C AND −10°C AT 12,000 FT.

NOTE

CIRCLES DENOTE CONDITIONS WHERE CRUISE PERFORMANCE IS PRESENTED. SHADED CIRCLES DENOTE CONDITIONS WHERE TWO ENGINE AND SINGLE ENGINE CRUISE PERFORMANCE IS PRESENTED.



AIRCRAFT OPERATION BELOW MINIMUM OPERATING TEMPERATURE LIMIT ARE SHOWN ON PERFORMANCE CHARTS AS DASHED LINES.

NO AIRCRAFT PERFORMANCE OR ENGINE OPERATING CHARACTERISTICS HAVE BEEN DEMONSTRATED ABOVE THE MAXIMUM OPERATING TEMPERATURE LIMIT.

AP 001390

Figure 7-24. Operation Envelope RU-21D

Section XIII. CRUISE CLIMB

7-70. Description. RU-21A

The Cruise Climb Chart (fig. 7-25), shows the time, fuel, and distance required to climb from sea level. For climb at other than the conditions of this chart, refer to Cruise Charts (fig. 7-27 thru fig. 7-74), and the Climb/Descent Chart (fig. 7-124).

7-71. Use of Chart. RU-21A

To determine the time, fuel and distance required to climb from one altitude to another, subtract the time, fuel and distance from sea level to the initial altitude.

7-72. Condition. RU-21A

a. Normal rated climb power at 2000 RPM.

b. Climb speed – 140 KIAS.

c. Flaps – UP.

d. Landing gear – UP.

e. Atmosphere – Temperature lapse rate is assumed to be linear from the initial altitude to the final altitude. Distances to climb are based on calm wind.

NOTE

Time and fuel to climb are not affected by wind.

CRUISE CLIMB

GEAR FLAPS UP CALM WIND POWER - NORMAL RATED CLIMB
CLIMB SPEED – 140 KIAS

CRUISE CLIMB
RU-21A
T74-CP-700

EXAMPLE

WANTED

TIME, FUEL AND DISTANCE REQUIRED TO CLIMB

KNOWN

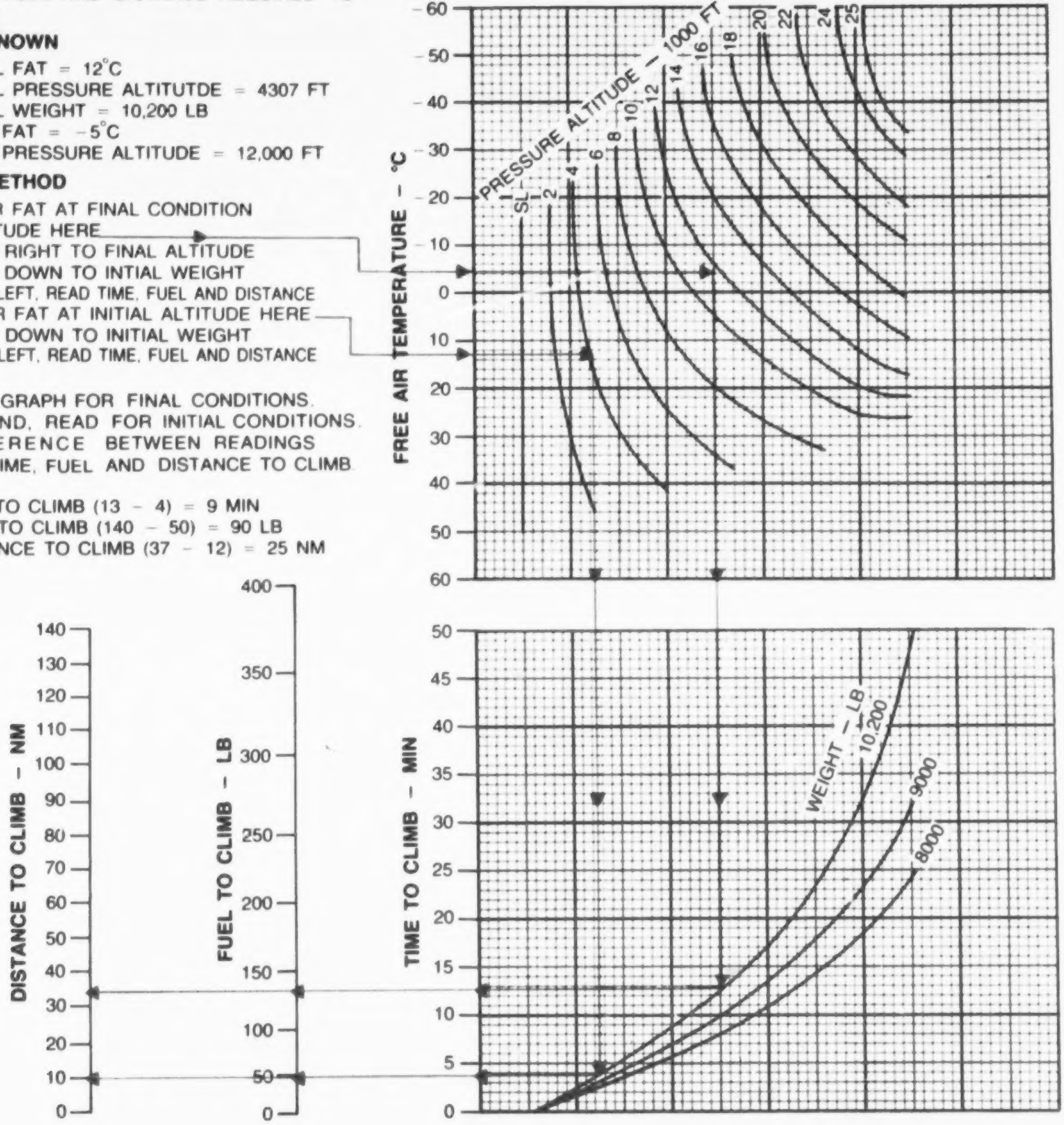
INITIAL FAT = 12°C
INITIAL PRESSURE ALTITUTDE = 4307 FT
INITIAL WEIGHT = 10,200 LB
FINAL FAT = −5°C
FINAL PRESSURE ALTITUDE = 12,000 FT

METHOD

ENTER FAT AT FINAL CONDITION ALTITUDE HERE
MOVE RIGHT TO FINAL ALTITUDE
MOVE DOWN TO INTIAL WEIGHT
MOVE LEFT, READ TIME, FUEL AND DISTANCE
ENTER FAT AT INITIAL ALTITUDE HERE
MOVE DOWN TO INITIAL WEIGHT
MOVE LEFT, READ TIME, FUEL AND DISTANCE

READ GRAPH FOR FINAL CONDITIONS. SECOND, READ FOR INITIAL CONDITIONS. DIFFERENCE BETWEEN READINGS IS TIME, FUEL AND DISTANCE TO CLIMB

TIME TO CLIMB (13 − 4) = 9 MIN
FUEL TO CLIMB (140 − 50) = 90 LB
DISTANCE TO CLIMB (37 − 12) = 25 NM



DATA BASIS: ESTIMATED

AP 001351

Figure 7-25. Cruise Climb RU-21A

7-73. Description. RU-21D

The Cruise Climb Chart (fig. 7-26), shows the time, fuel, and distance required to climb from sea level. For climb at other than the conditions of this chart, refer to Cruise Charts (fig. 7-75 thru fig. 7-123), and the Climb/Descent Chart (fig. 7-125).

7-74. Use of Chart. RU-21D

To determine the time, fuel and distance required to climb from one altitude to another, subtract the time, fuel and distance from sea level to the initial altitude.

7-75. Condition. RU-21D

a. Normal rated climb power at 2000 RPM.

b. Climb speed – 140 KIAS.

c. Flaps – UP.

d. Landing gear – UP.

e. Atmopshere – Temperature lapse rate is assumed to be linear from the initial altitude to the final altitude. Distances to climb are based on calm wind.

NOTE

Time and fuel to climb are not affected by wind.

CRUISE CLIMB

GEAR UP FLAPS 0 PERCENT CALM WIND
POWER – MAXIMUM CRUISE CLIMB

CRUISE CLIMB
RU-21D
T74-CP-700

EXAMPLE

WANTED

TIME, FUEL AND DISTANCE REQUIRED TO CLIMB

KNOWN

INITIAL FAT = 12°C
INITIAL PRESSURE ALTITUDE = 4307 FT
INITIAL WEIGHT = 9650 LBS
FINAL FAT = -5°C
FINAL PRESSURE ALTITUDE = 12,000 FT

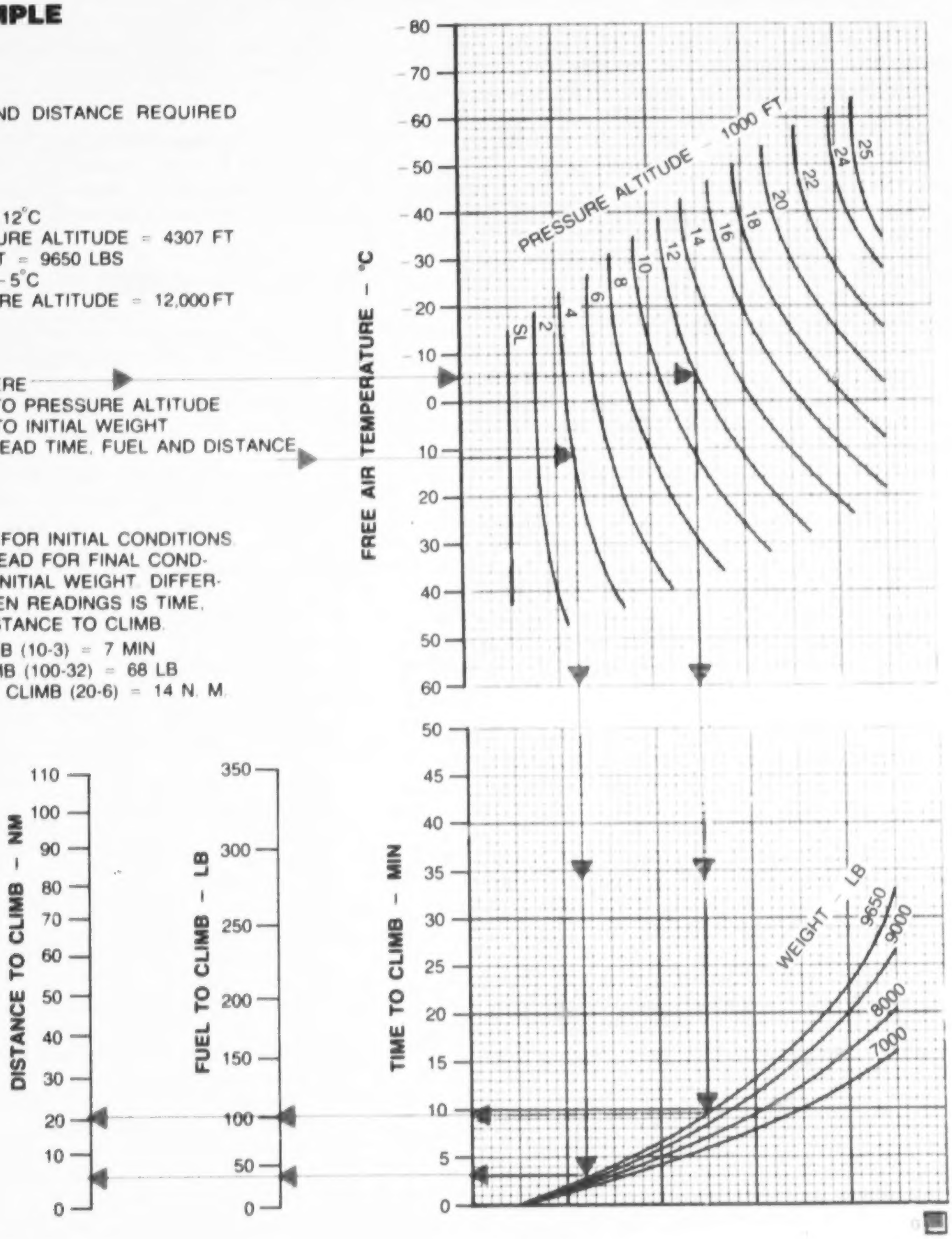
METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN TO INITIAL WEIGHT
MOVE LEFT, READ TIME, FUEL AND DISTANCE

NOTE

READ GRAPH FOR INITIAL CONDITIONS. SECONDLY, READ FOR FINAL CONDITIONS WITH INITIAL WEIGHT. DIFFERENCE BETWEEN READINGS IS TIME, FUEL AND DISTANCE TO CLIMB.

TIME TO CLIMB (10-3) = 7 MIN
FUEL TO CLIMB (100-32) = 68 LB
DISTANCE TO CLIMB (20-6) = 14 N. M.



DATA BASIS: FLIGHT TEST

AP 001391

Figure 7-26. Cruise Climb RU-21D

Section XIV. CRUISE

7-76. Description. RU-21A

The Cruise Charts (fig. 7-27 thru fig. 7-74), show the horsepower per engine for various airspeeds and weights at selected combinations of altitude and temperature. Cruise and climb fuel flows are shown corresponding to engine power. Maximum performance lines are shown. Torque variation with propeller speed and engine horsepower are shown. Two engine and single-engine data are presented on the chart. Each individual chart is for a single pressure altitude and FAT.

7-77. Use of Chart. RU-21A

The primary use of the Cruise Chart is shown in Cruise examples (fig. 7-27). Other uses for the chart are described under "Other uses for Chart" (para. 7-77). The Cruise charts are for use in determining power settings to obtain a desired level of performance for a known set of conditions of altitude, temperature, weight and number of operating engines. Normally, sufficient accuracy can be obtained by selecting the chart nearest to the planned cruising altitude and temperature. If greater accuracy is desired, interpolation between two or more charts should be used. The power setting is obtained by adjusting torque and propeller speed.

a. Maximum Range. The maximum range line shows the airspeed which will provide the maximum range for a given aircraft weight at the chart conditions.

b. Maximum Endurance. The maximum endurance line shows the airspeed which will provide maximum endurance for a given aircraft weight at the chart conditions.

c. Maximum Rate Of Climb. The maximum rate of climb line shows the airspeed which would provide maximum rate of climb for a given aircraft weight if maximum horsepower was used at the chart conditions.

d. Airspeed. The relationship between indicated and true airspeed is shown for the specific chart conditions of altitude and temperature. Conversion between the two airspeeds can be accomplished without regard to other chart information.

e. Fuel Flow. The fuel flow for cruise and climb settings is shown.

NOTE

Fuel flow values should be doubled for two engine operation.

f. Horsepower Per Engine. Horsepower per engine, although not readable in the cockpit is utilized in conjunction with the Climb/Descent Chart (fig. 7-124), to obtain rate of climb or descent.

7-78. Conditions. RU-21A

a. Configuration. All cruise data are based on the aircraft in a clean configuration.

b. Fuel. Fuel flow is based on use of JP-4 aviation fuel.

c. Operation. Areas not recommended for cruise operation are shown in yellow.

7-79. Other Uses of Chart. RU-21A

a. Selected True Airspeed.

Wanted
Indicated airspeed, horsepower per engine
Fuel flow, and torque for a selected cruise true airspeed

Known
Pressure altitude
FAT
Weight
Prop RPM

Method
Enter chart for true airspeed
Move right
Read indicated airspeed
Move down from weight line
Read horsepower per engine
Move down
Read fuel flow
Move left from prop RPM
Read torque

b. Climb Conditions.

Wanted
Maximum rate-of-climb airspeed
Horsepower required for level flight at MAX R/C airspeed

CRUISE

PRESSURE ALTITUDE 12,000 FT EXAMPLE
FLAPS UP GEAR UP

CRUISE
RU-21A
T74-CP-700

EXAMPLE

WANTED

TRUE AIRSPEED, INDICATED AIRSPEED, HORSEPOWER PER ENGINE, FUEL FLOW PER ENGINE, AND TORQUE PER ENGINE FOR MAX RANGE CRUISE

KNOWN

WEIGHT = 9000 LB
PRESSURE ALTITUDE = 12,000 FT
FAT = -5°C
PROP SPEED = 1900 RPM

METHOD 1 (SIMPLEST)

USE CHART FOR NEXT HIGHER CONDITION (0°C)
ENTER MAX RANGE HERE
MOVE RIGHT AND UP TO WEIGHT
MOVE RIGHT, READ TRUE AIRSPEED = 176 KT
MOVE LEFT, READ INCIDATED AIRSPEED = 142 KT
MOVE DOWN, READ HORSEPOWER PER ENGINE = 255 SHP
MOVE DOWN, READ FUEL FLOW PER ENGINE = 196 LB/HR
MOVE LEFT FROM PROP RPM, READ TORQUE PER ENGINE = 710 FT-LB

METHOD 2 (INTERPOLATE)

READ TRUE AIRSPEED, INDICATED AIRSPEED, HORSEPOWER, FUEL FLOW, AND TORQUE AT EACH ADJACENT ALTITUDE AND FAT, THEN INTERPOLATE

ALTITUDE	12,000 FT	12,000 FT	12,000 FT
FAT	-10°C	-5°C	0°C
TRUE AIRSPEED	174	175	176
INDICATED AIRSPEED	143	143	142
HORSEPOWER	256	256	255
FUEL FLOW	194	195	196
TORQUE	713	712	710

EXAMPLE

WANTED

TRUE AIRSPEED, INDICATED AIRSPEED, HORSEPOWER PER ENGINE, FUEL FLOW PER ENGINE, AND TORQUE PER ENGINE, TO BE FOR NORMAL RATED POWER (MAXIMUM TORQUE USED FOR CRUISE)

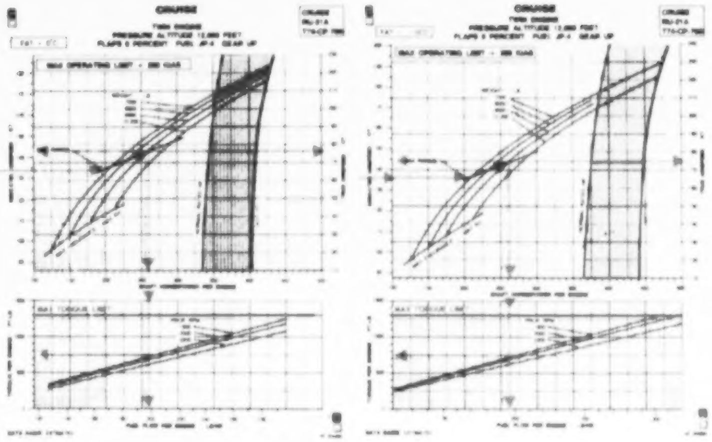
KNOWN

WEIGHT = 9000 LB
PRESSURE ALTITUDE = 12,000 FT
FAT = 0°C
PROP SPEED = 1900 RPM

MEHTOD

ENTER 9000 LB LINE AT LOWEST AIRSPEED.
MOVE UP AND TO THE RIGHT TO NORMAL RATED HP LINE.
MOVE RIGHT, READ TRUE AIRSPEED = 203 KT
MOVE LEFT, READ INDICATED AIRSPEED = 165 KT.
MOVE DOWN, READ MAXIMUM CRUISE HORSEPOWER PER ENGINE = 352 SHP
MOVE DOWN, AND LEFT, READ MAXIMUM CRUISE TORQUE = 971 FT-LB.

DATA BASIS: ESTIMATED



EXAMPLE

WANTED

MAX RATE OF CLIMB, INDICATED AIRSPEED, HORSEPOWER PER ENGINE FOR LEVEL FLIGHT AT MAX R/C AIRSPEED, MAX CONT. HORSEPOWER AVAILABLE, EXCESS HORSEPOWER AVAILABLE FOR CLIMB, FUEL FLOW AND TORQUE FOR MAX CLIMB

KNOWN

WEIGHT = 9000 LB
PRESSURE ALTITUDE = 12,000 FT
FAT = 0°C
PROP SPEED = 2200 RPM

METHOD

ENTER CHART AT MAX R/C LINE
MOVE RIGHT AND UP TO WEIGHT = 9000 LB
MOVE LEFT, READ MAX R/C INDICATED AIRSPEED = 109 KTS
MOVE DOWN FROM WEIGHT LINE, READ HORSEPOWER REQUIRED FOR LEVEL FLIGHT AT MAX R/C AIRSPEED = 179 SHP
MOVE DOWN FROM MAX CONT. HP LINE, READ MAX CONT. HORSEPOWER AVAILABLE = 405 SHP
MOVE DOWN FROM MAX CONT. HP AVAILABLE, READ CLIMB FUEL FLOW = 274 LB/HR
MOVE LEFT FROM PROP RPM LINE, READ TORQUE TO SET FOR CLIMB = 971 FT-LB
DETERMINE EXCESS HORSEPOWER PER ENGINE AVAILABLE FOR CLIMB — MAX CONT. HORSEPOWER AVAILABLE, LESS HORSEPOWER REQUIRED FOR LEVEL FLIGHT = 405 SHP - 179 SHP = 226 SHP PER ENGINE

AP 000847

Figure 7-27. Cruise Example **RU-21A**

Max horsepower available
Fuel flow and torque for MAX R/C
Excess horsepower available for climb

Known
Pressure altitude
OAT
Weight
Prop RPM

Method
Enter chart at MAX R/C Line
Move right and up to weight
Move left and read MAX R/C true airspeed
Move right and read MAX R/C indicated airspeed
Move down from weight line
Read horsepower per engine for level flight at MAX R/C airspeed
Read MAX horsepower available per engine at MAX R/C airspeed
Move down from MAX horsepower available
Read climb fuel flow
Move left from prop RPM line
Read torque
Determine excess horsepower per engine available for climb - MAX horsepower available per engine less horsepower per engine for level flight

(7-59 blank)

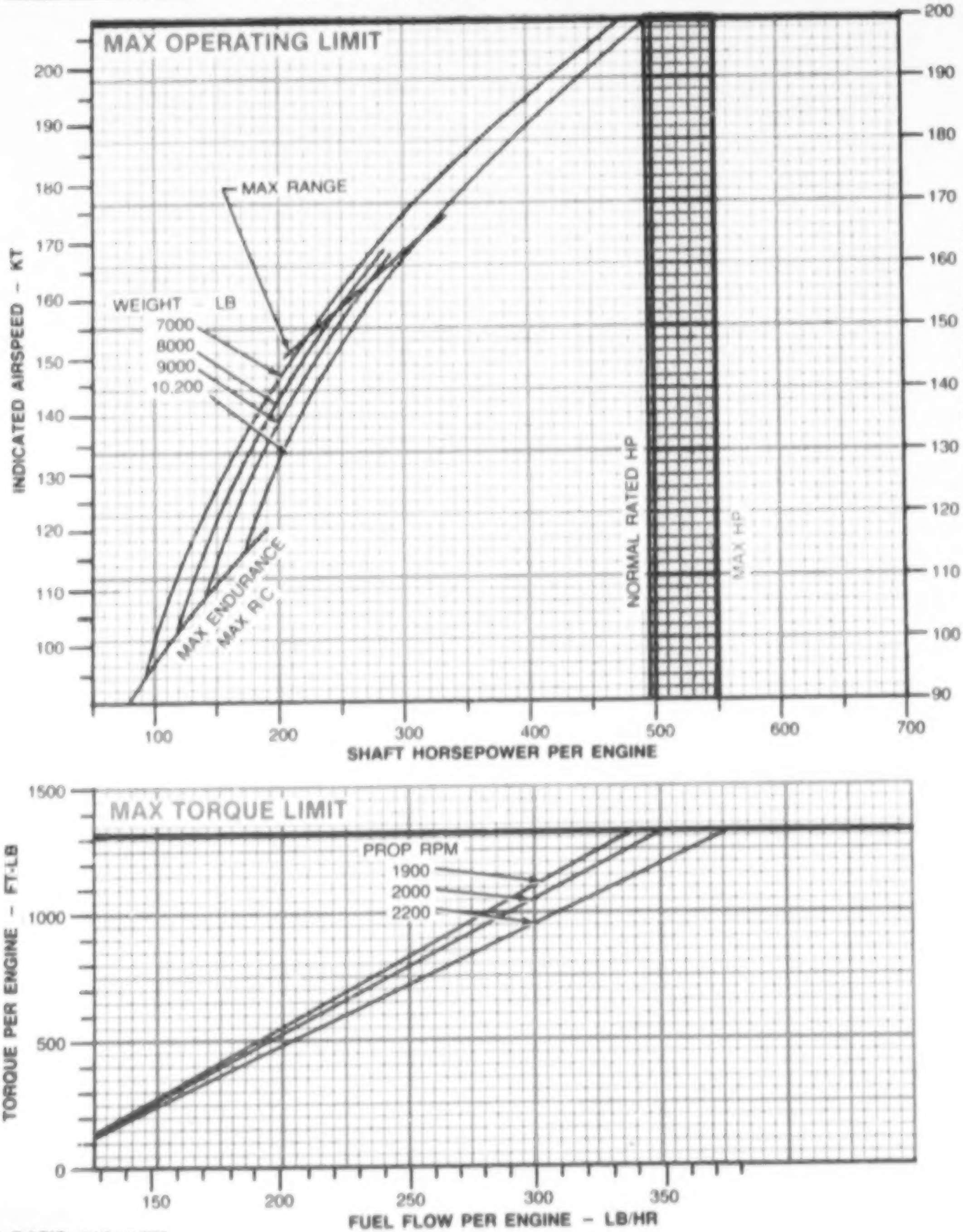
■
□

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C

CRUISE
RU-21A
T74-CP-700



DATA BASIS: ESTIMATED

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AP003978.1

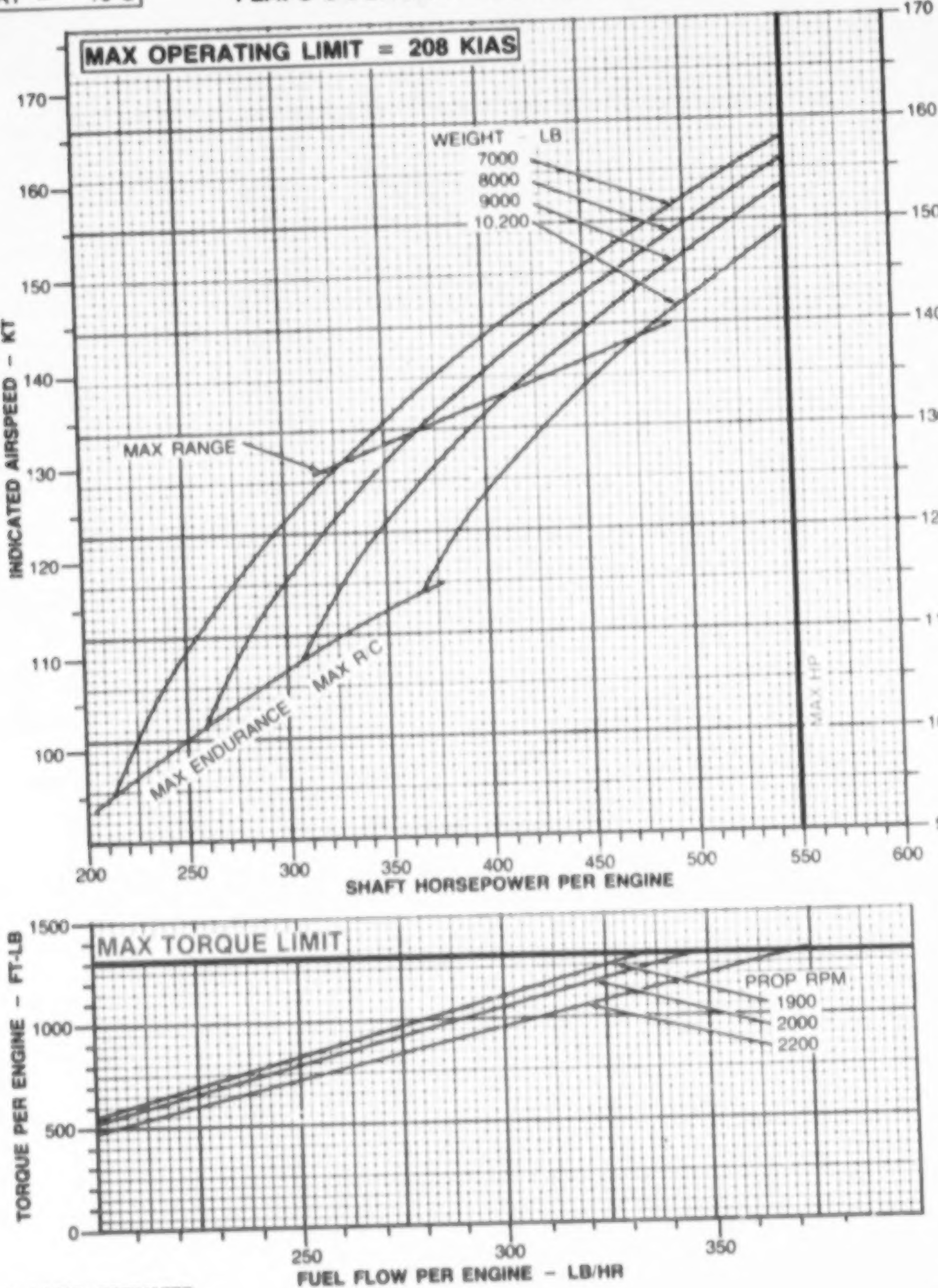
Figure 7-28. Cruise FAT −10°C, Sea Level **RU-21A** *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21A
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -10°C



DATA BASIS: ESTIMATED

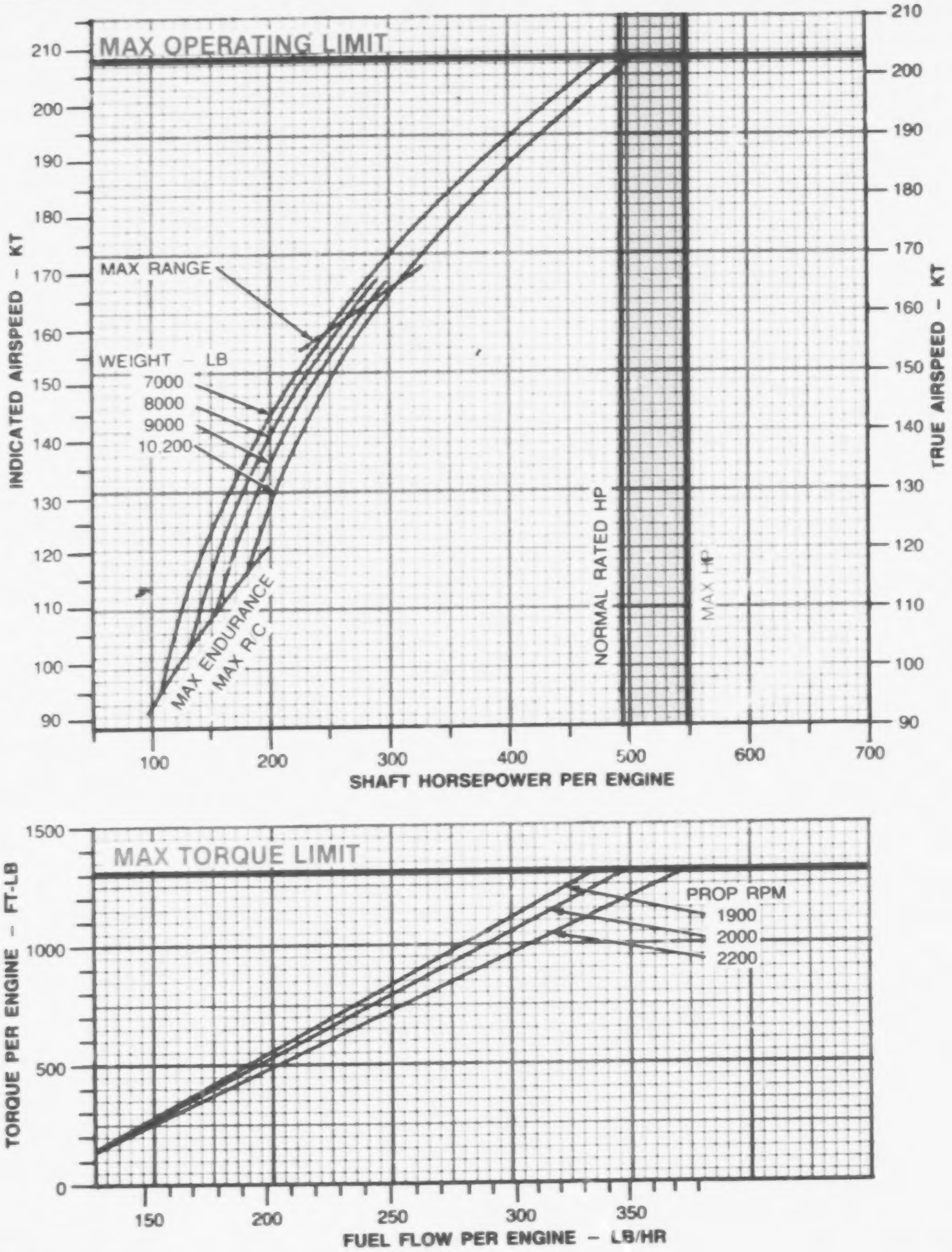
Figure 7-28. Cruise FAT -10°C, Sea Level RU-21A (Sheet 2 of 2)

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

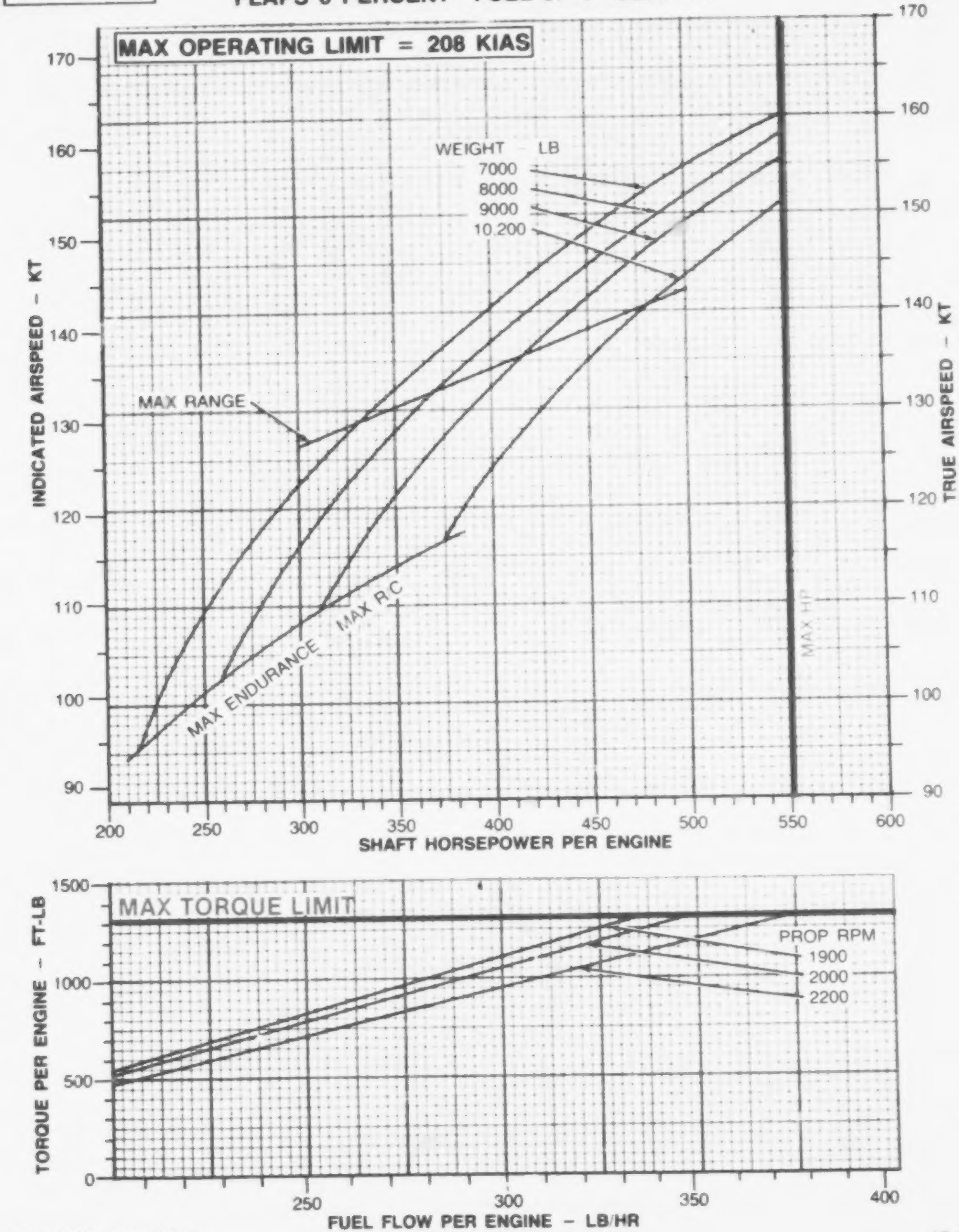
AP004003 1

Figure 7-29. Cruise FAT 0°C, Sea Level **RU-21A** *(Sheet 1 of 2)*

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

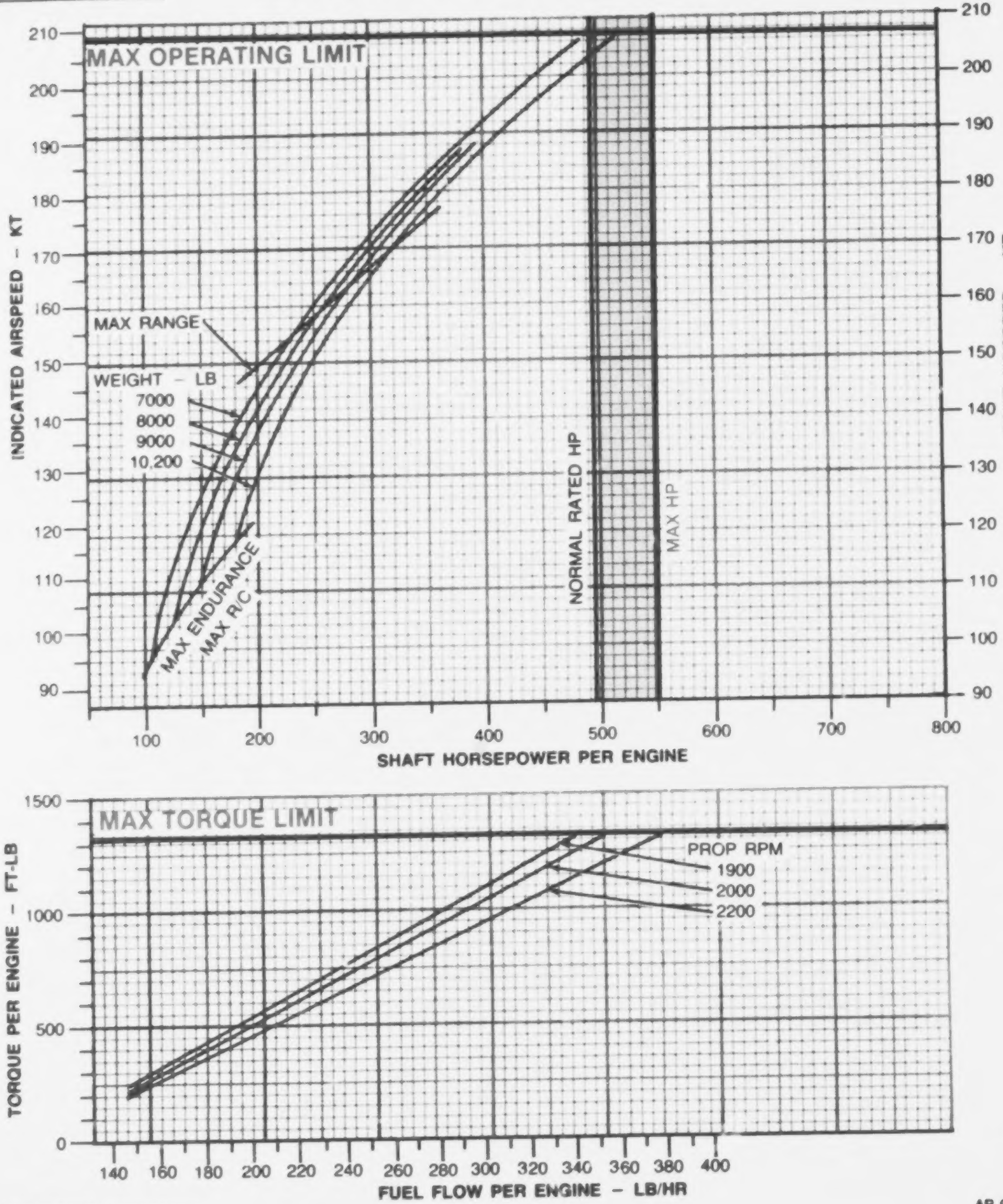
Figure 7-29. Cruise FAT 0°C, Sea Level **RU-21A** *(Sheet 2 of 2)*

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



DATA BASIS: ESTIMATED

R

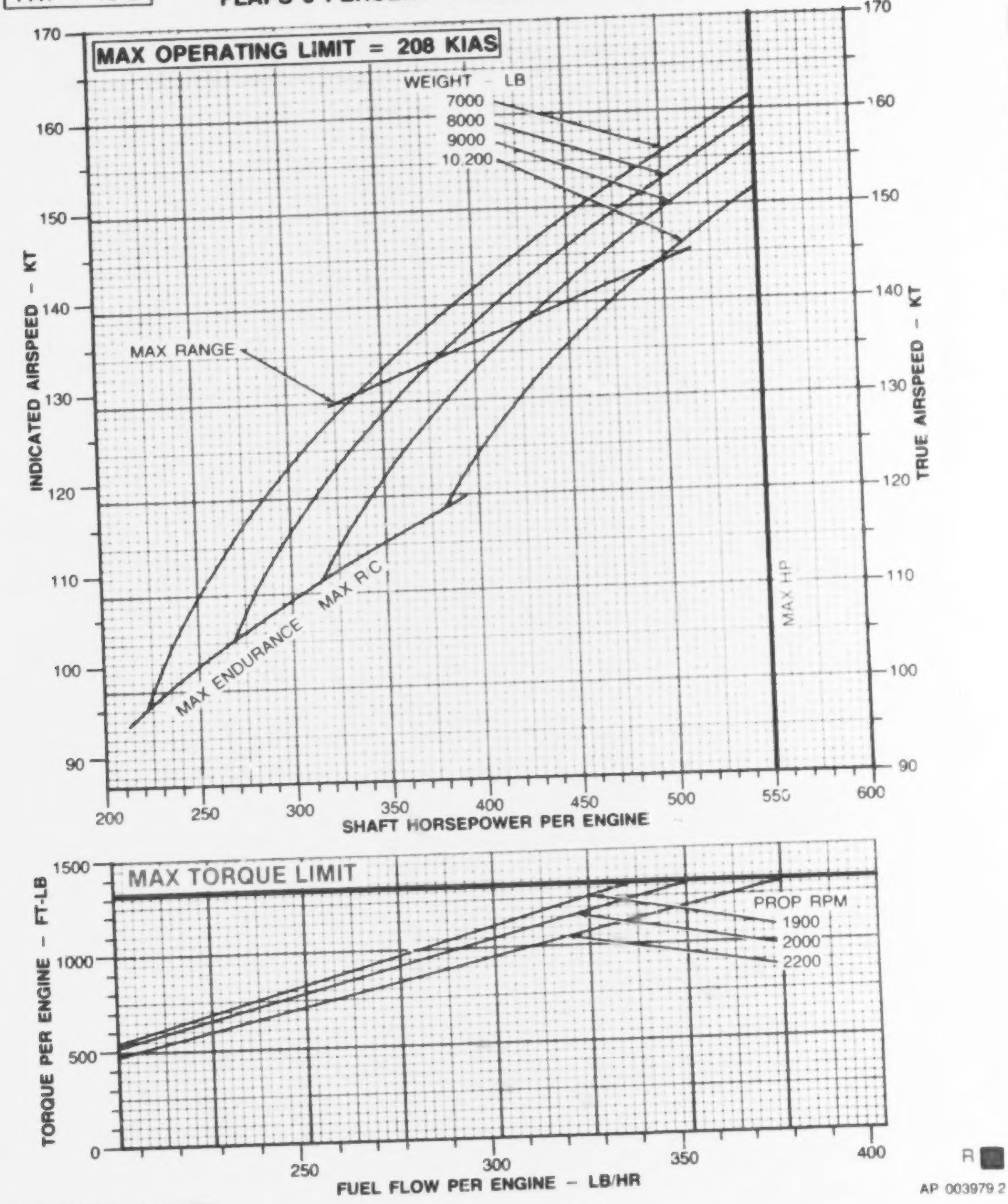
AP 003979.1

Figure 7-30. Curise FAT 10°C, Sea Level RU-21A *(Sheet 1 of 2)*

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



DATA BASIS: ESTIMATED

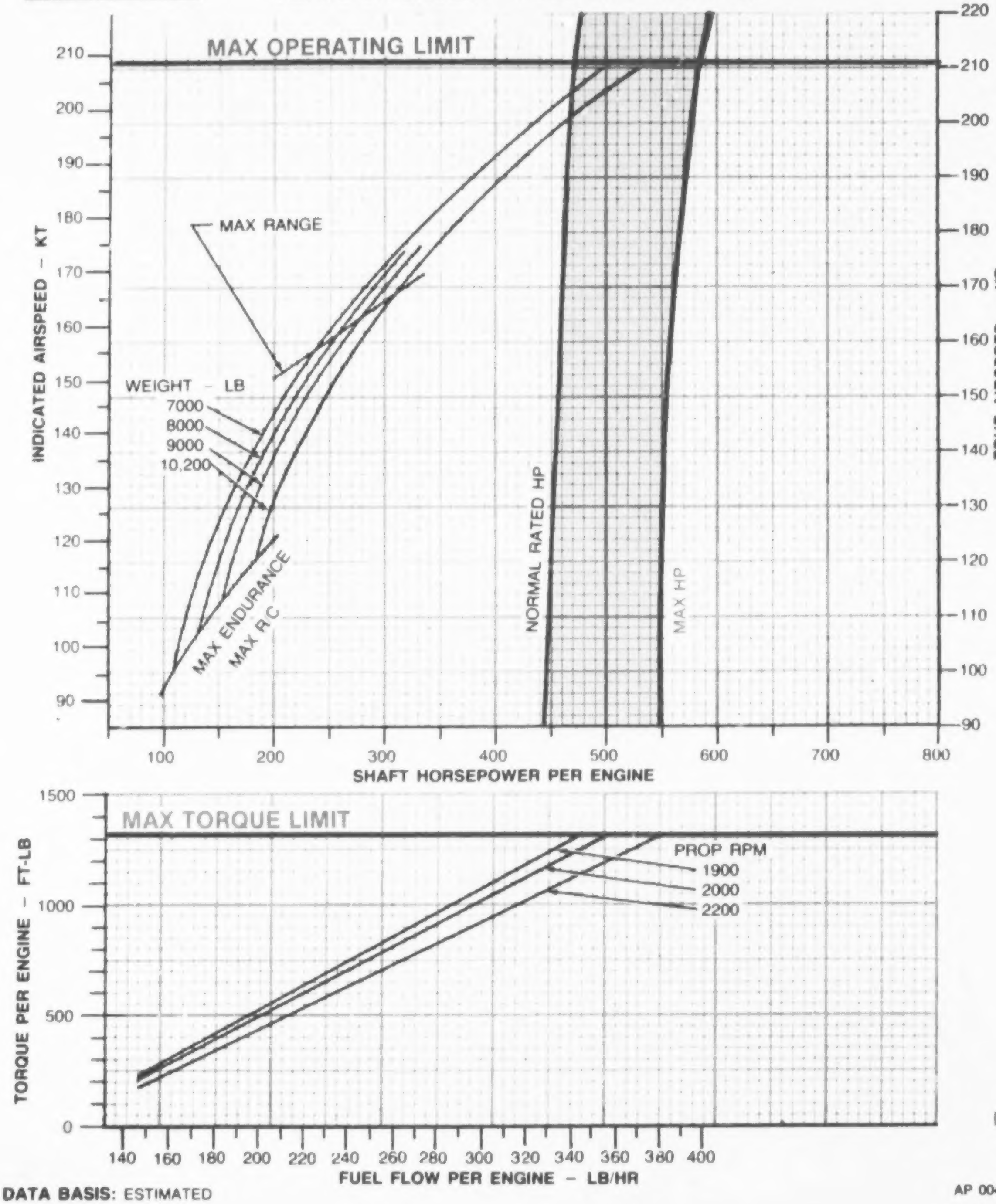
Figure 7-30. Cruise FAT 10°C, Sea Level RU-21A *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C

CRUISE
RU-21A
T74-CP-700



DATA BASIS: ESTIMATED

AP 004004.1

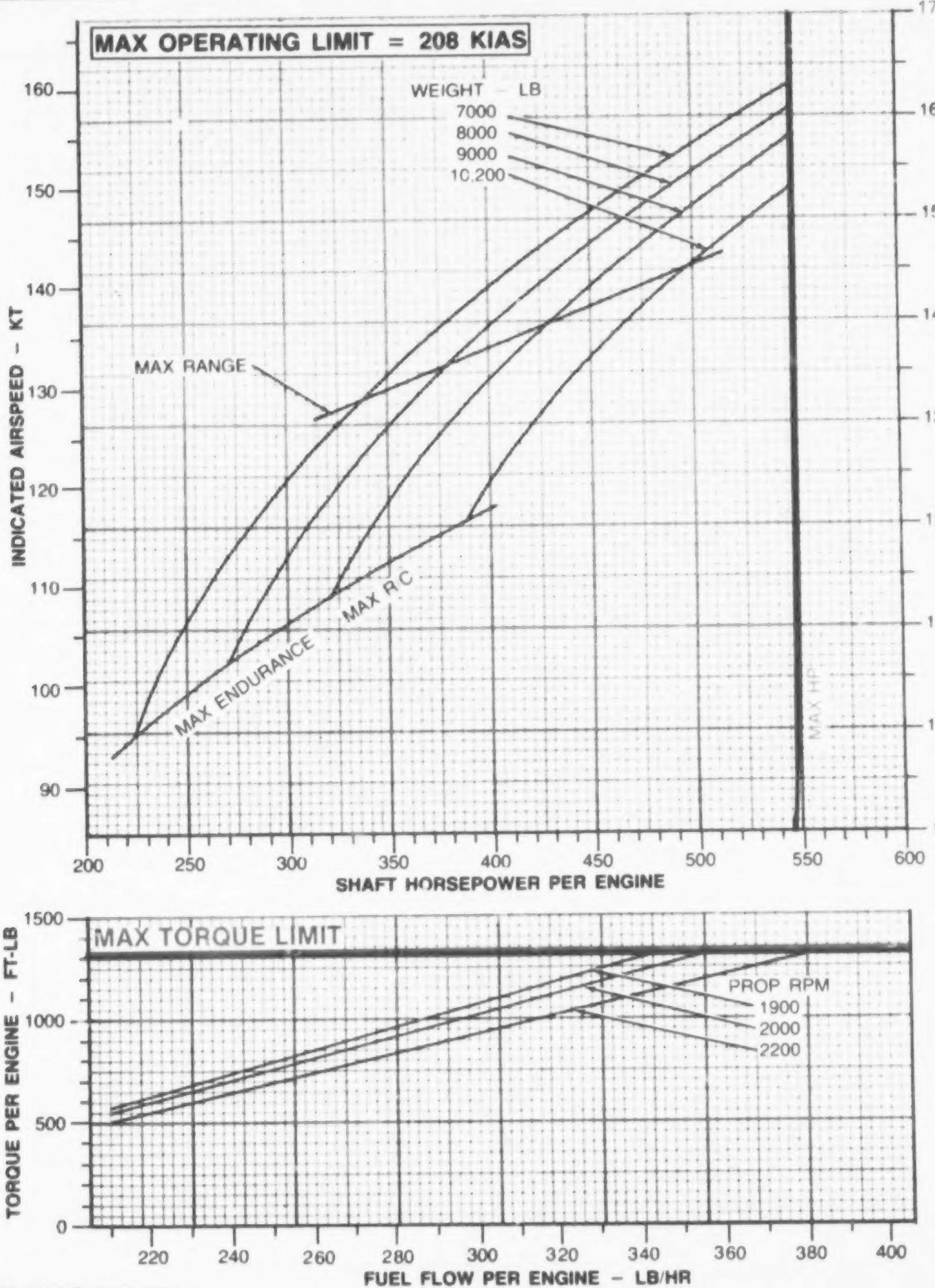
Figure 7-31. Cruise FAT 20°C, Sea Level **RU-21A** *(Sheet 1 of 2)*

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C

CRUISE
RU-21A
T74-CP-700



DATA BASIS: ESTIMATED

AP 004004 2

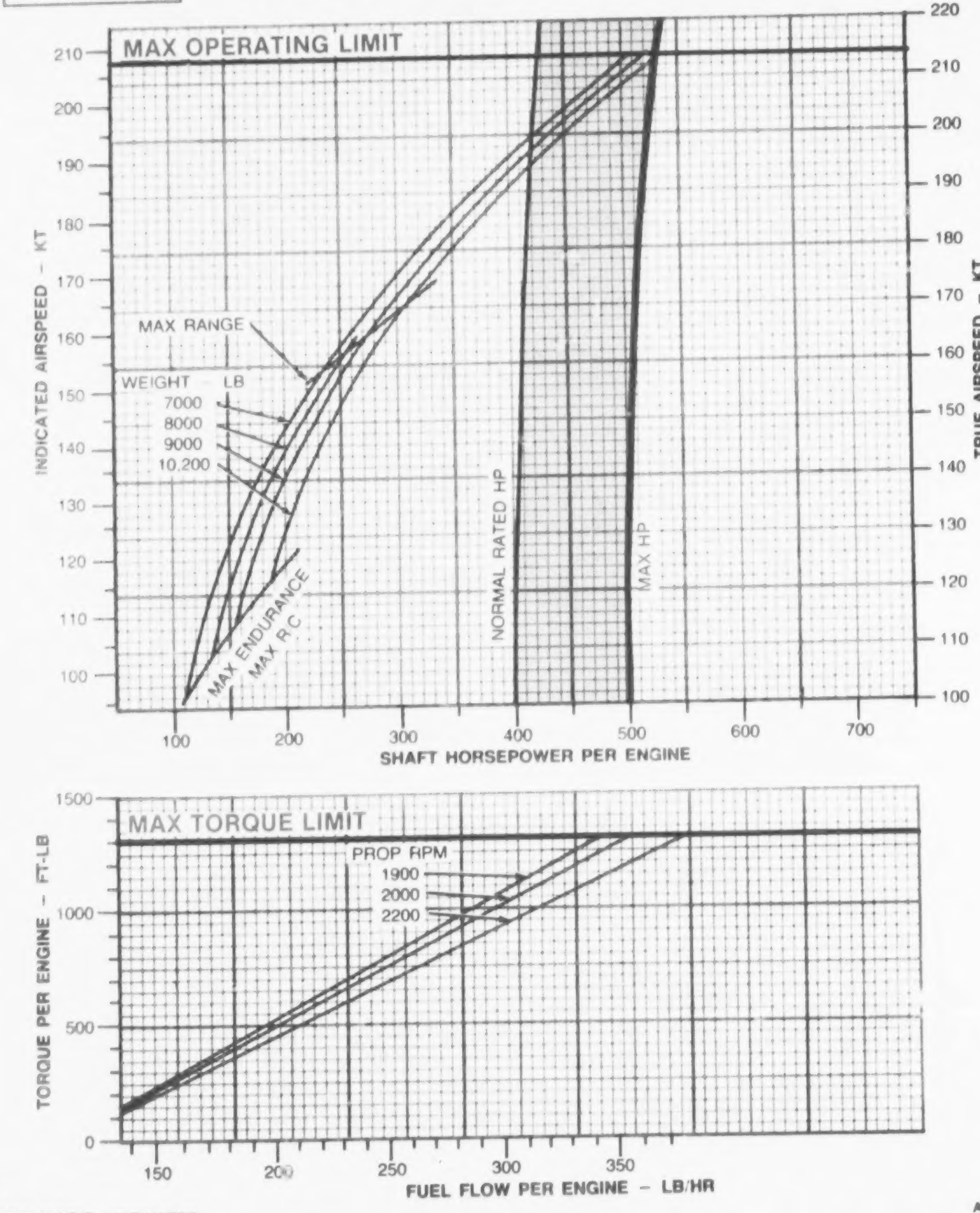
Figure 7-31. Ctuise FAT 20°C, Sea Level **RU-21A** *(Sheet 2 of 2)*

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 30°C



DATA BASIS: ESTIMATED

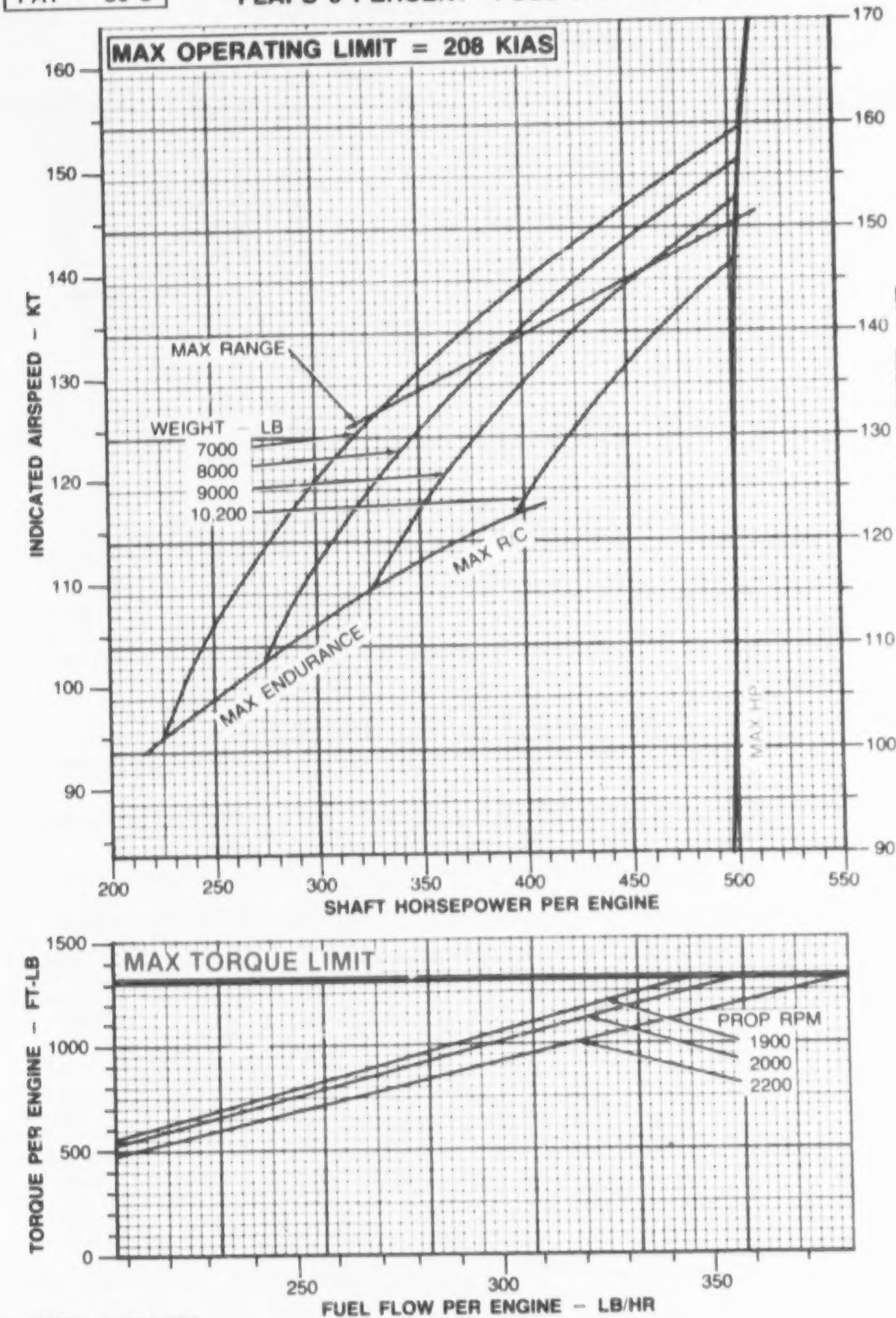
AP003980 1

Figure 7-32. Cruise FAT 30°C, Sea Level RU-21A (Sheet 1 of 2)

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 30°C



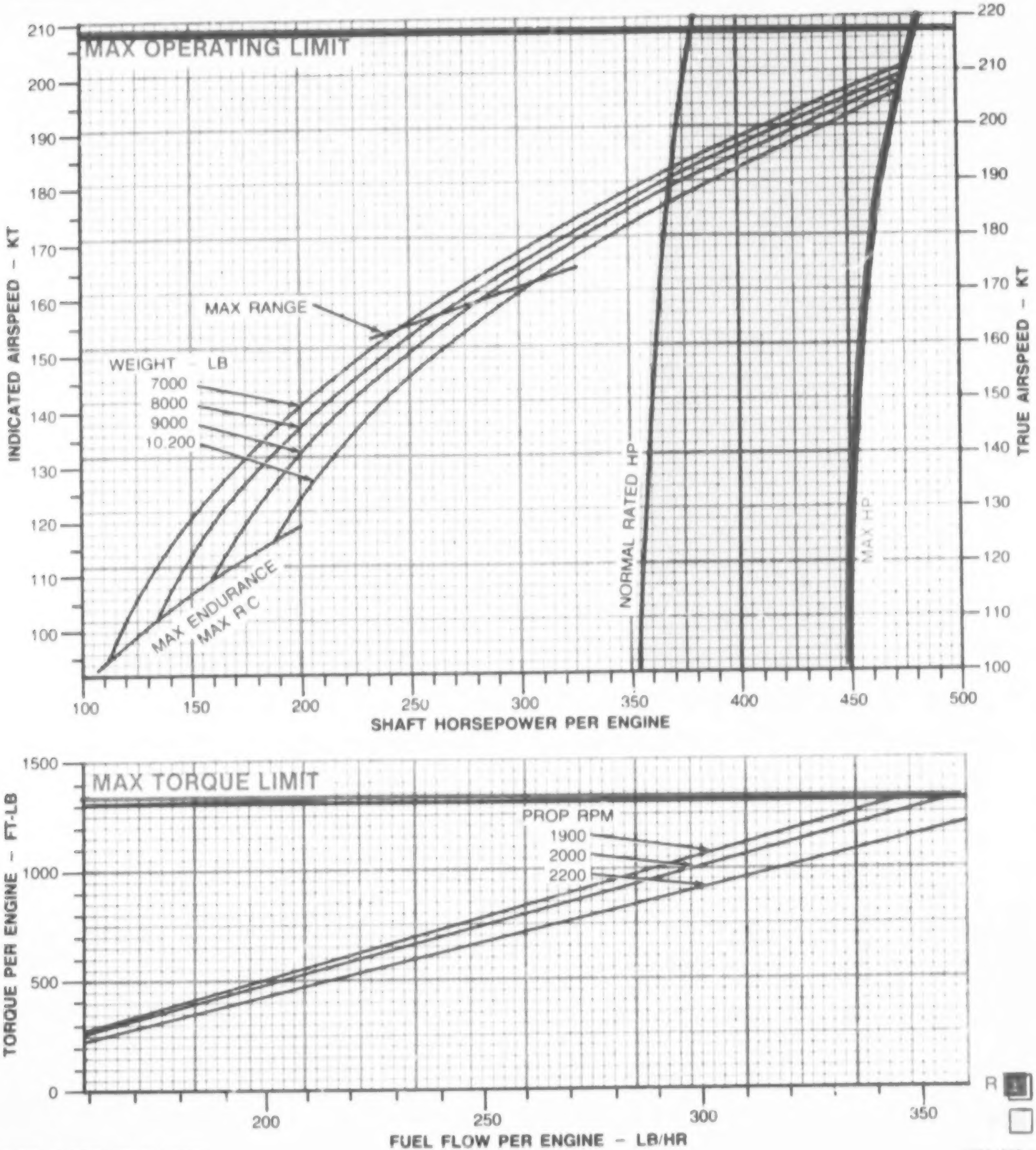
DATA BASIS: ESTIMATED

Figure 7-32. Cruise FAT 30°C, Sea Level **RU-21A** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 40°C



DATA BASIS: ESTIMATED

AP004005.1

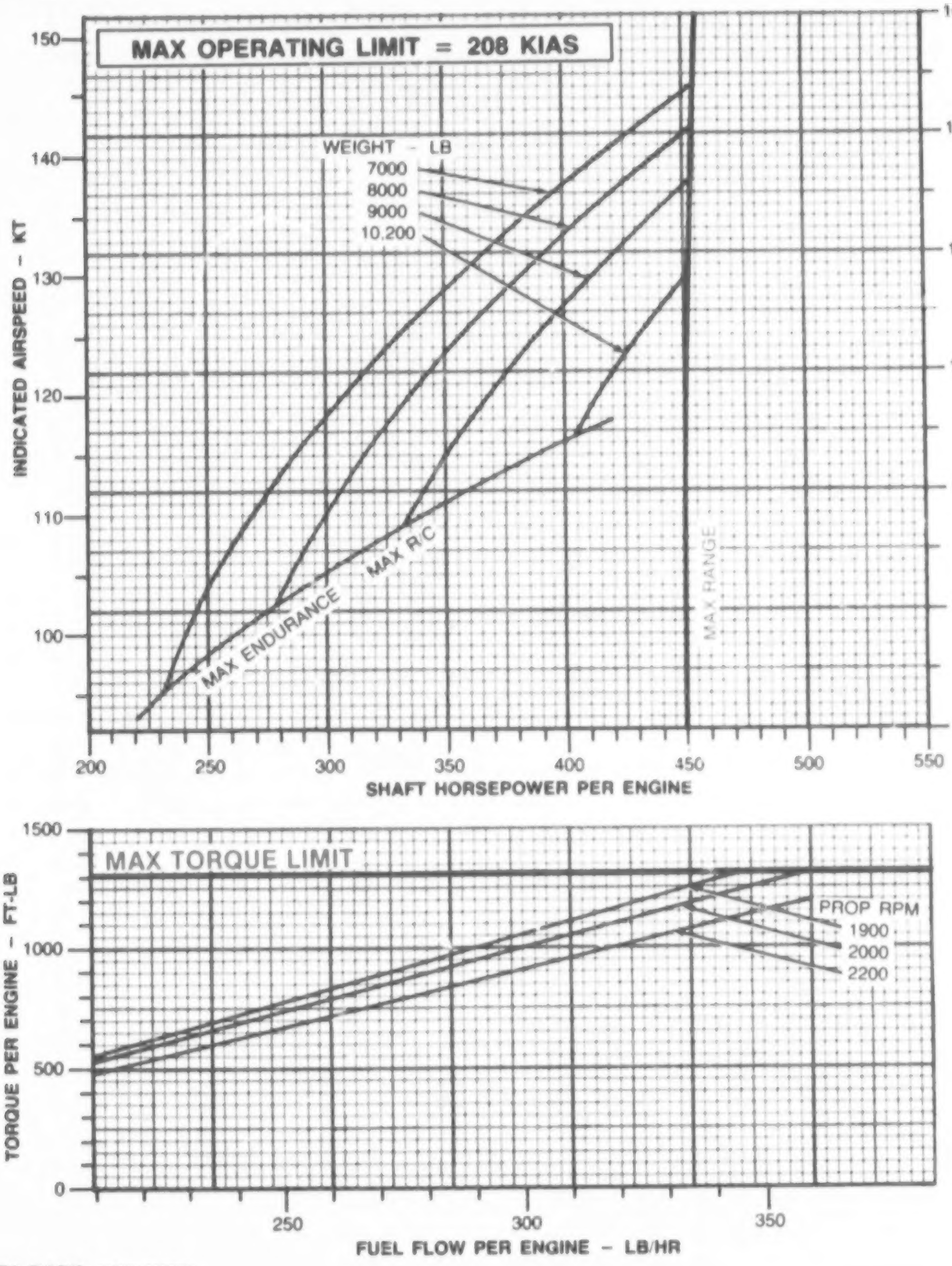
Figure 7-33. Cruise FAT 40°C, Sea Level **RU-21A** *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21A
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 40°C



DATA BASIS: ESTIMATED

R

AP 004005 2

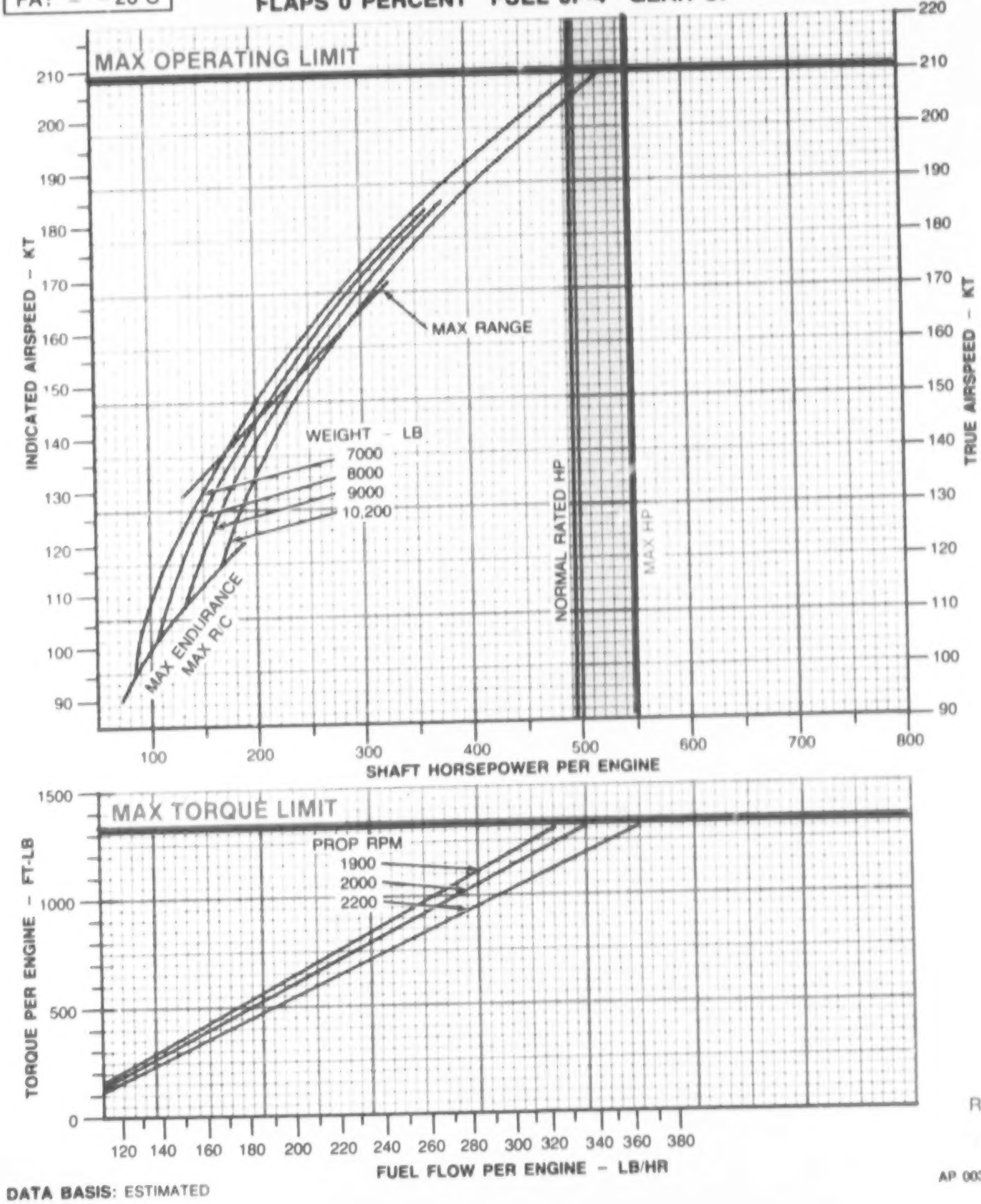
Figure 7-33. Cruise FAT 40°C, Sea Level RU-21A (Sheet 2 of 2)

CRUISE
RU-21A
T74-CP-700

FAT = −20°C

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP



DATA BASIS: ESTIMATED

AP 003981.1

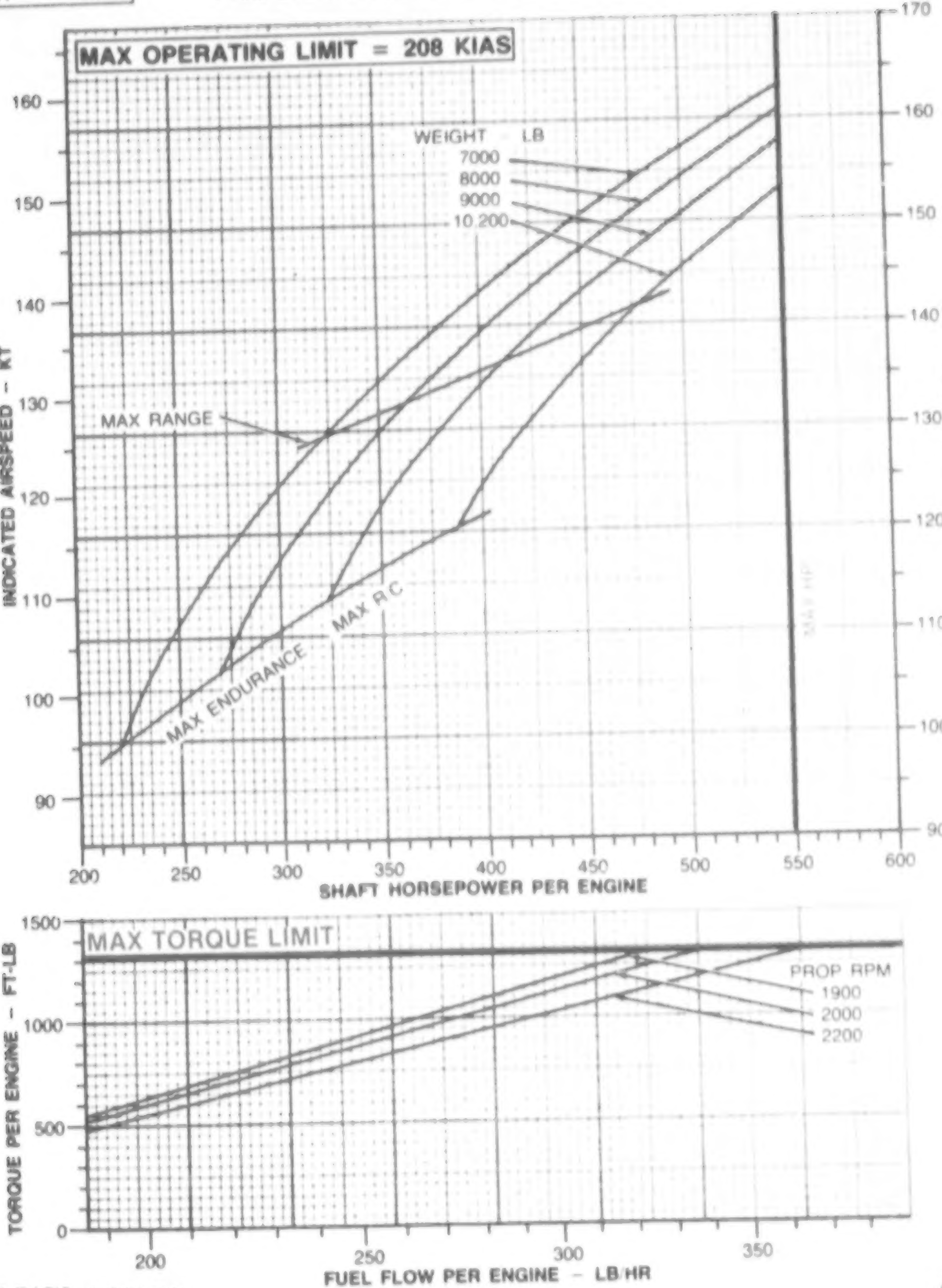
Figure 7-34. Cruise FAT −20°C, 4000 Ft RU-21A *(Sheet 1 of 2)*

CRUISE
RU-21A
T74-CP-700

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C



DATA BASIS: ESTIMATED

R

AP 003981.2

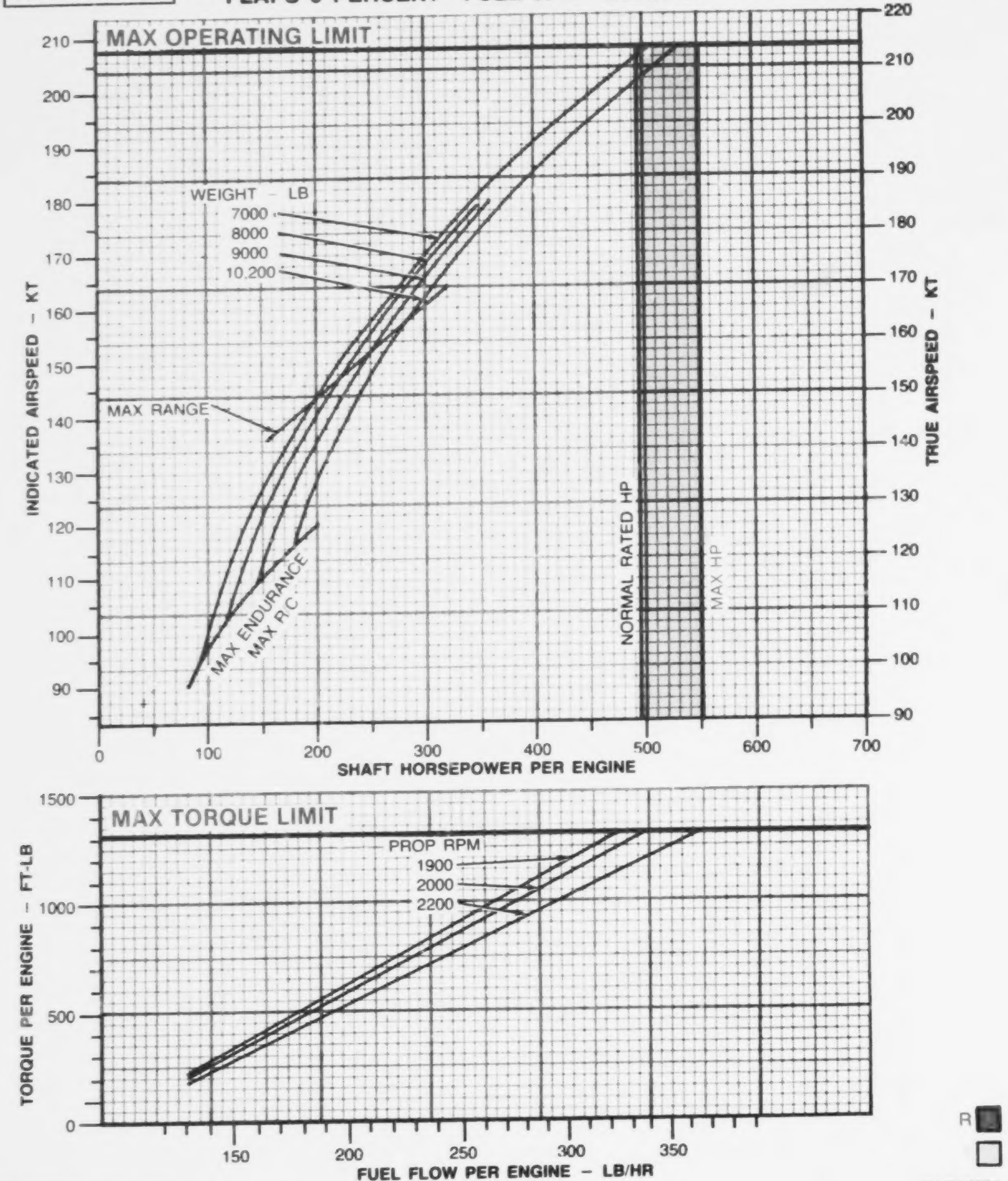
Figure 7-34. Cruise FAT −20°C, 4000 Ft **RU-21A** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -10°C

CRUISE
RU-21A
T74-CP-700



DATA BASIS: ESTIMATED

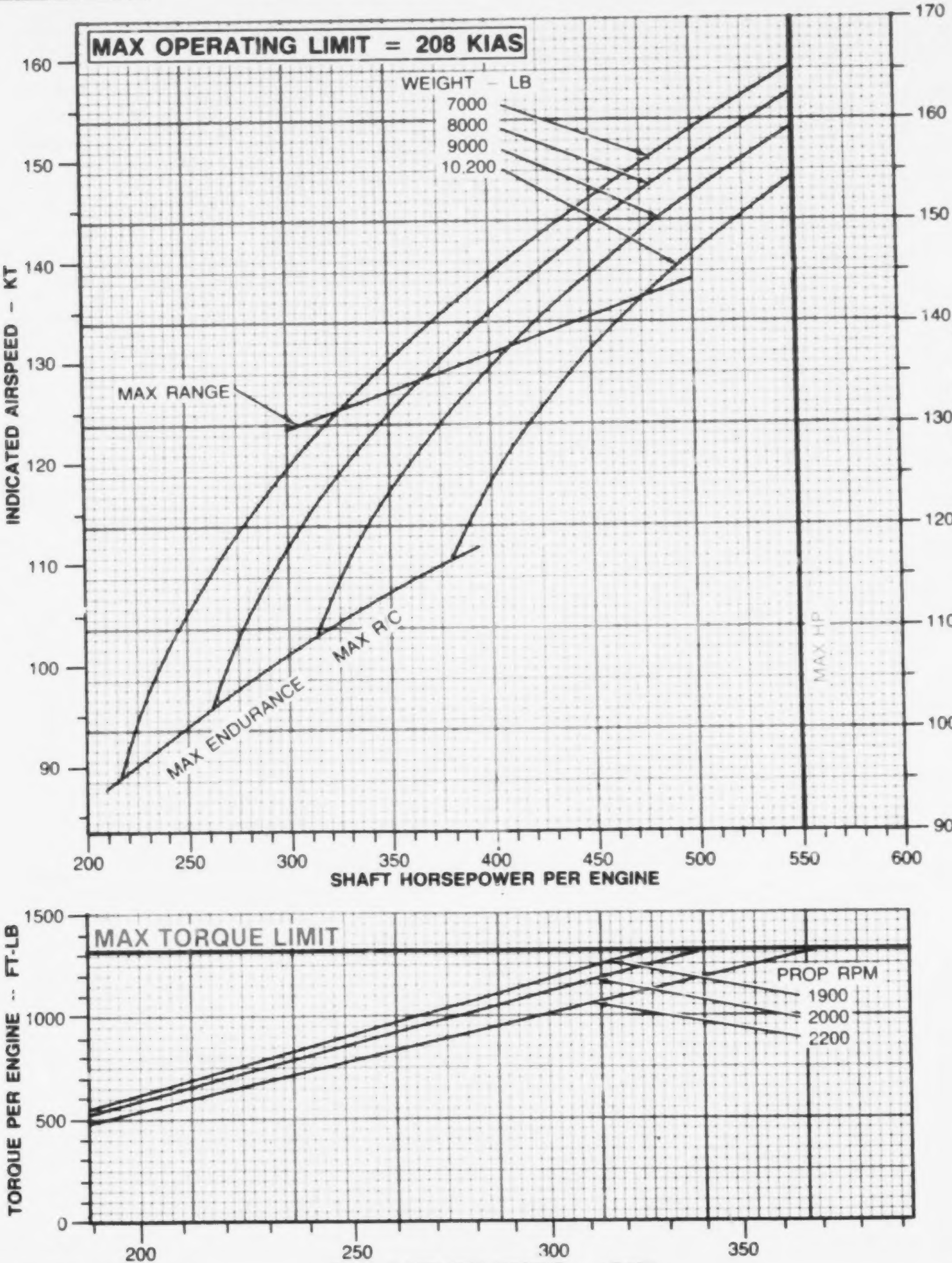
AP 004006.1

Figure 7-35. Cruise FAT -10°C, 4000 Ft **RU-21A** *(Sheet 1 of 2)*

CRUISE

SINGLE ENGINE
PRESSURE ALITITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



DATA BASIS: ESTIMATED

AP 004006.2

Figure 7-35. Cruise FAT −10°C, 4000 Ft **RU-21A** *(Sheet 2 of 2)*

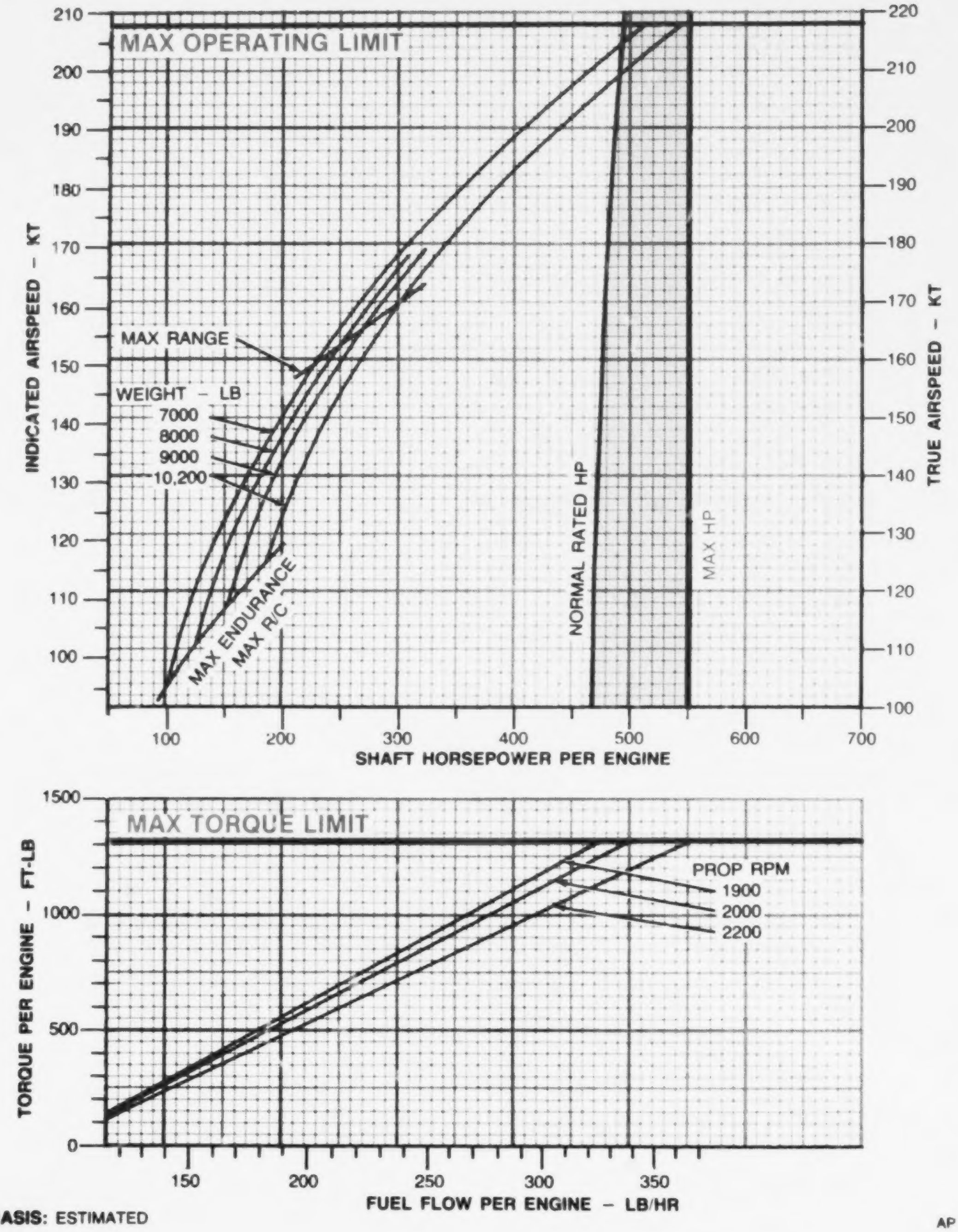
best copy available

CRUISE
RU-21A
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

AP 003982 1

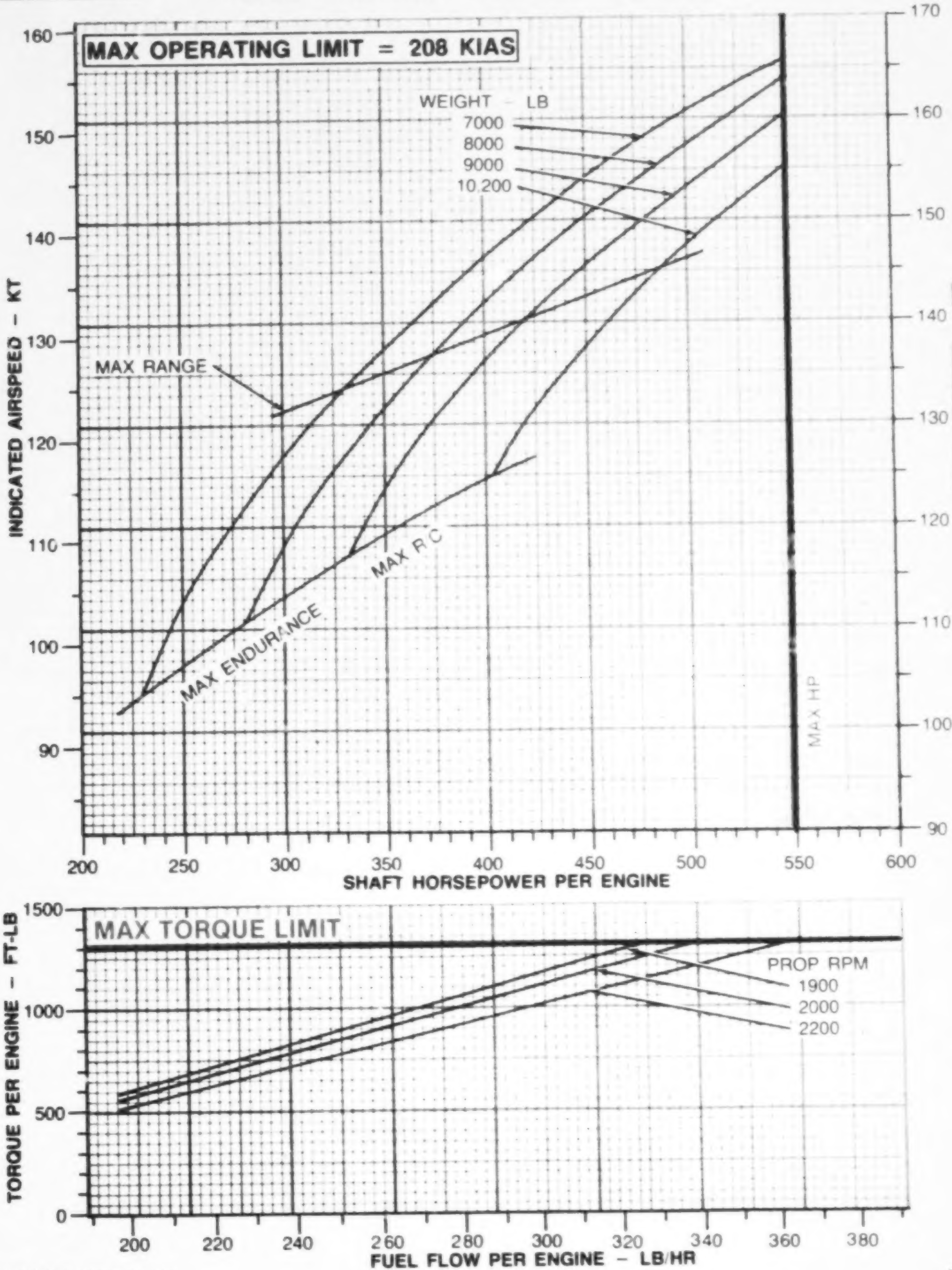
Figure 7-36. Cruise FAT 0°C, 4000 Ft **RU-21A** *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21A
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

R

AP 003982.2

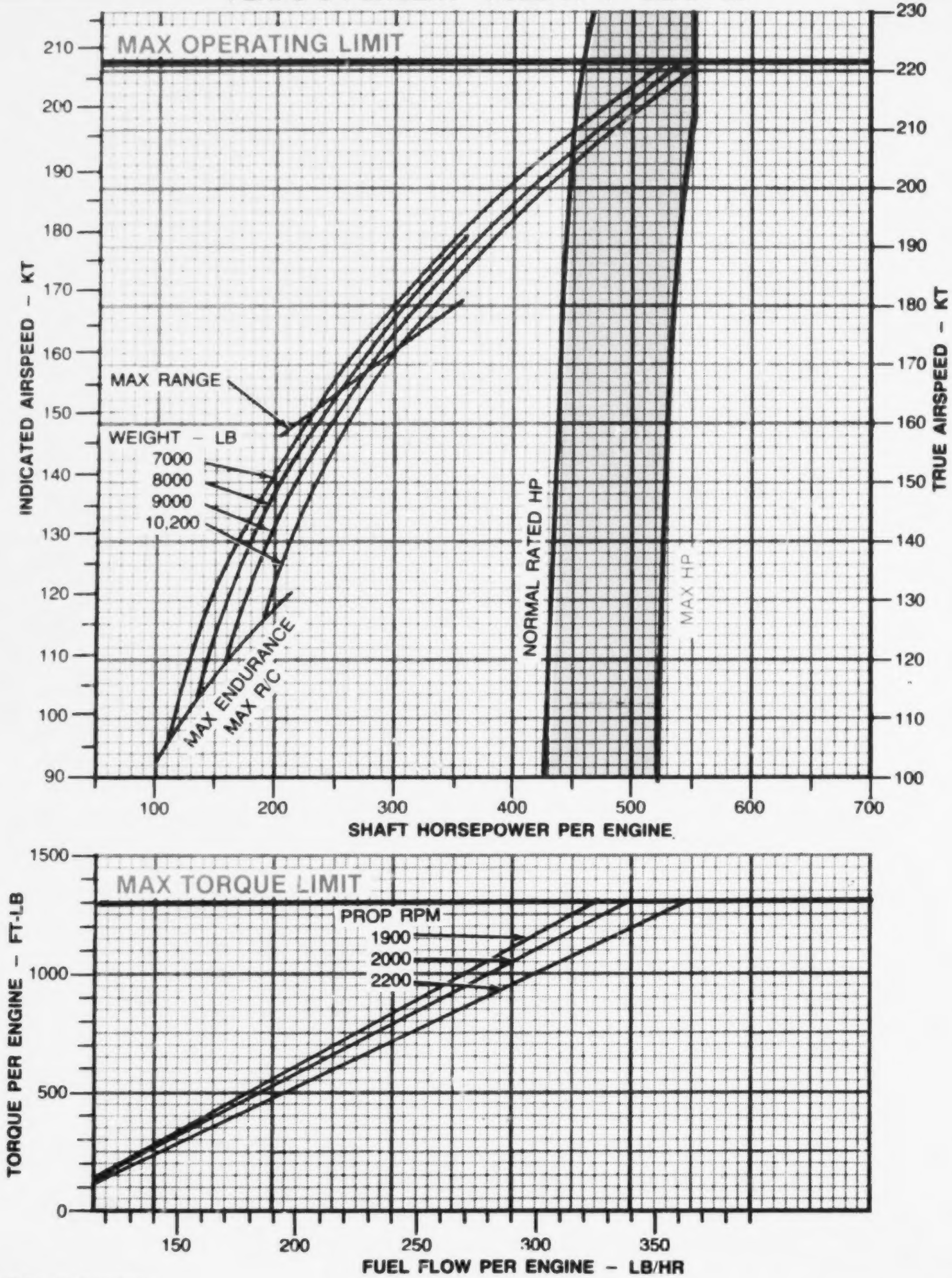
Figure 7-36. Cruise FAT 0°C, 4000 Ft **RU-21A** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C

CRUISE
RU-21A
T74-CP-700



DATA BASIS: ESTIMATED

AP 004007.1

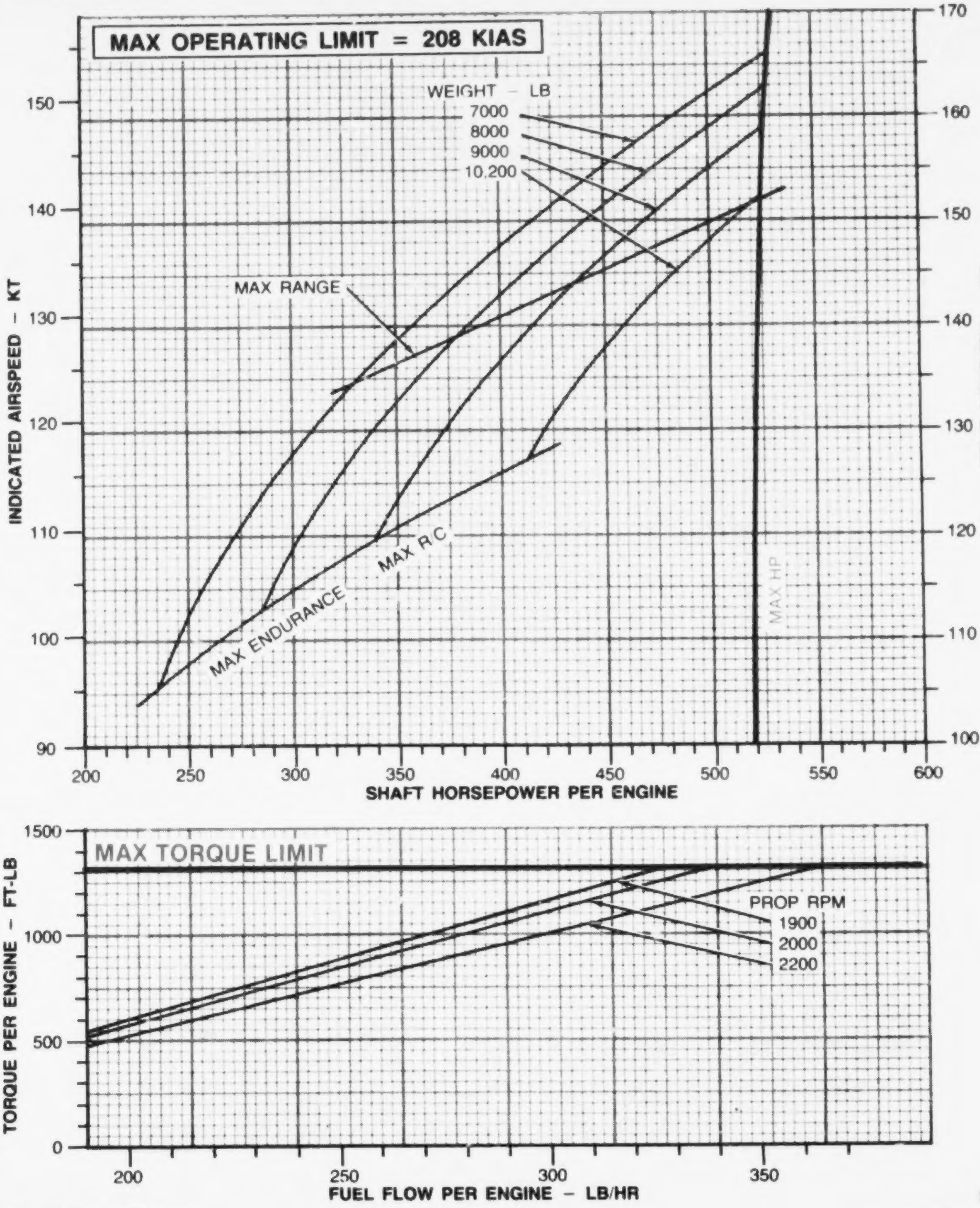
Figure 7-37. Cruise FAT 10°C, 4000 Ft RU-21A *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21A
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



DATA BASIS: ESTIMATED

AP 004007.2

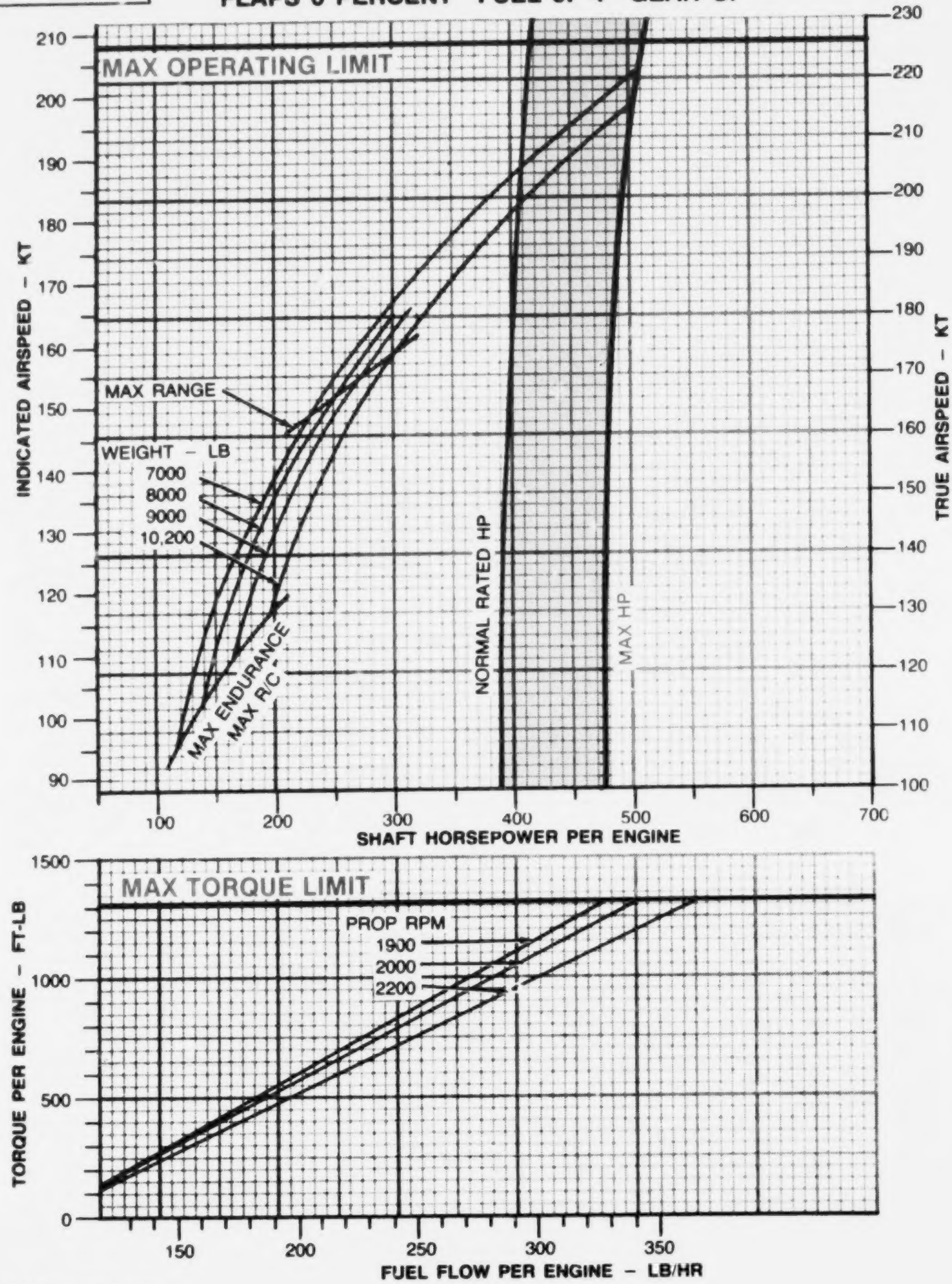
Figure 7-37. Cruise FAT 10°C, 4000 Ft RU-21A *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21A
T74-CP-700

FAT = 20°C



DATA BASIS: ESTIMATED

AP 003983.1

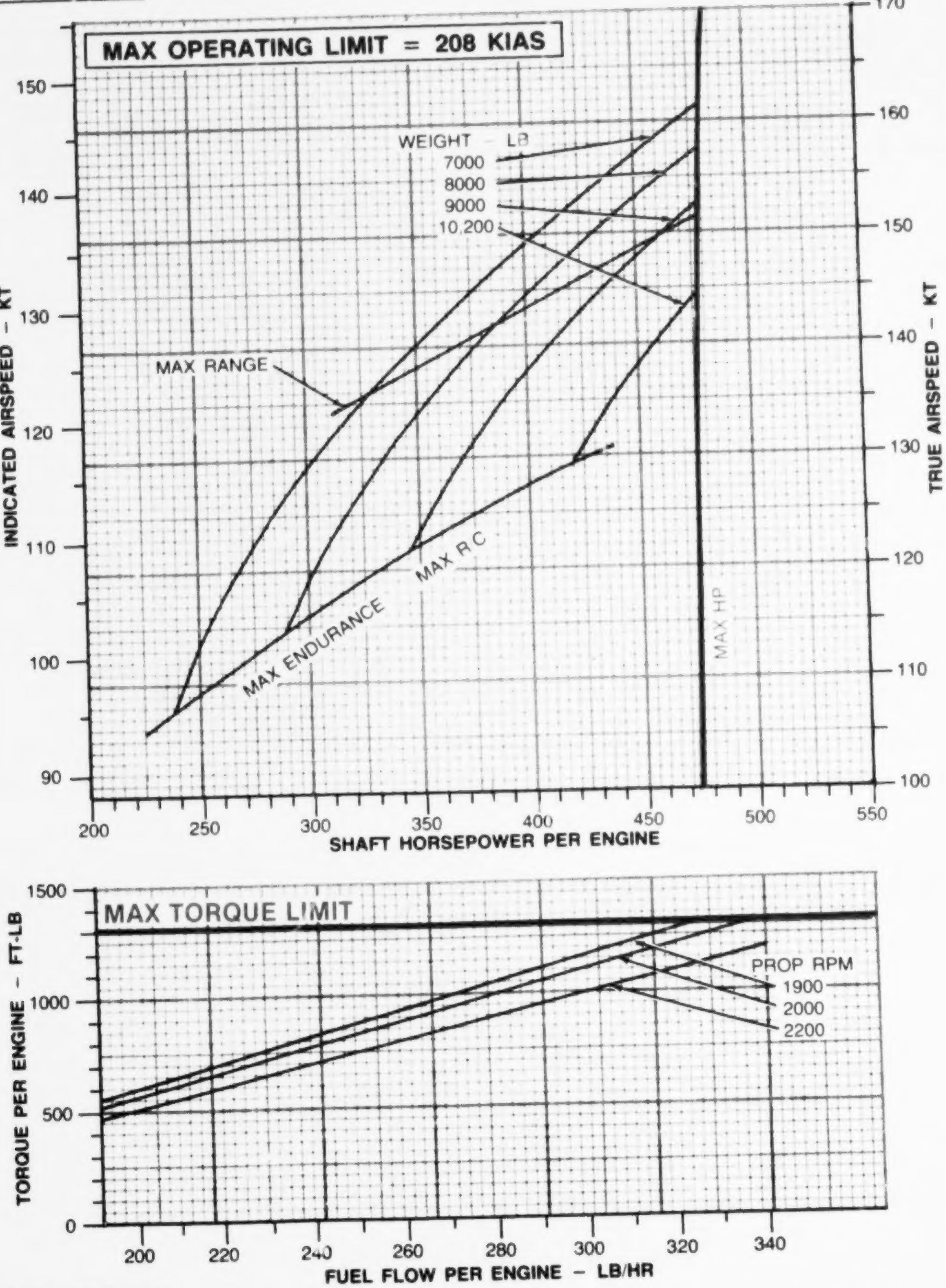
Figure 7-38. Cruise FAT 20°C, 4000 Ft **RU-21A** *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21A
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C



R

AP 003983.2

DATA BASIS: ESTIMATED

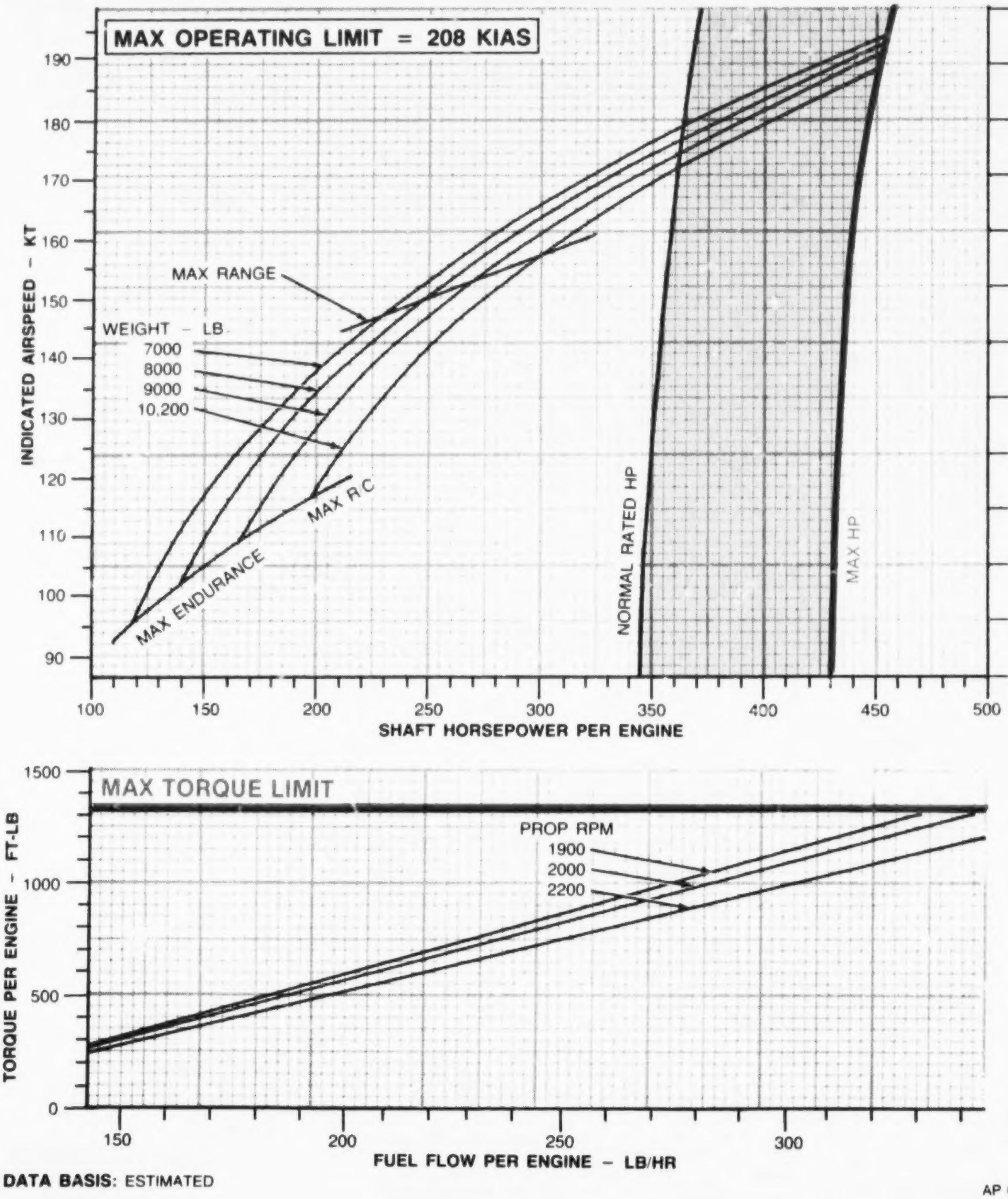
Figure 7-38. Cruise FAT 20°C, 4000 Ft **RU-21A** *(Sheet 2 of 2)*

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 30°C



DATA BASIS: ESTIMATED

AP 004281

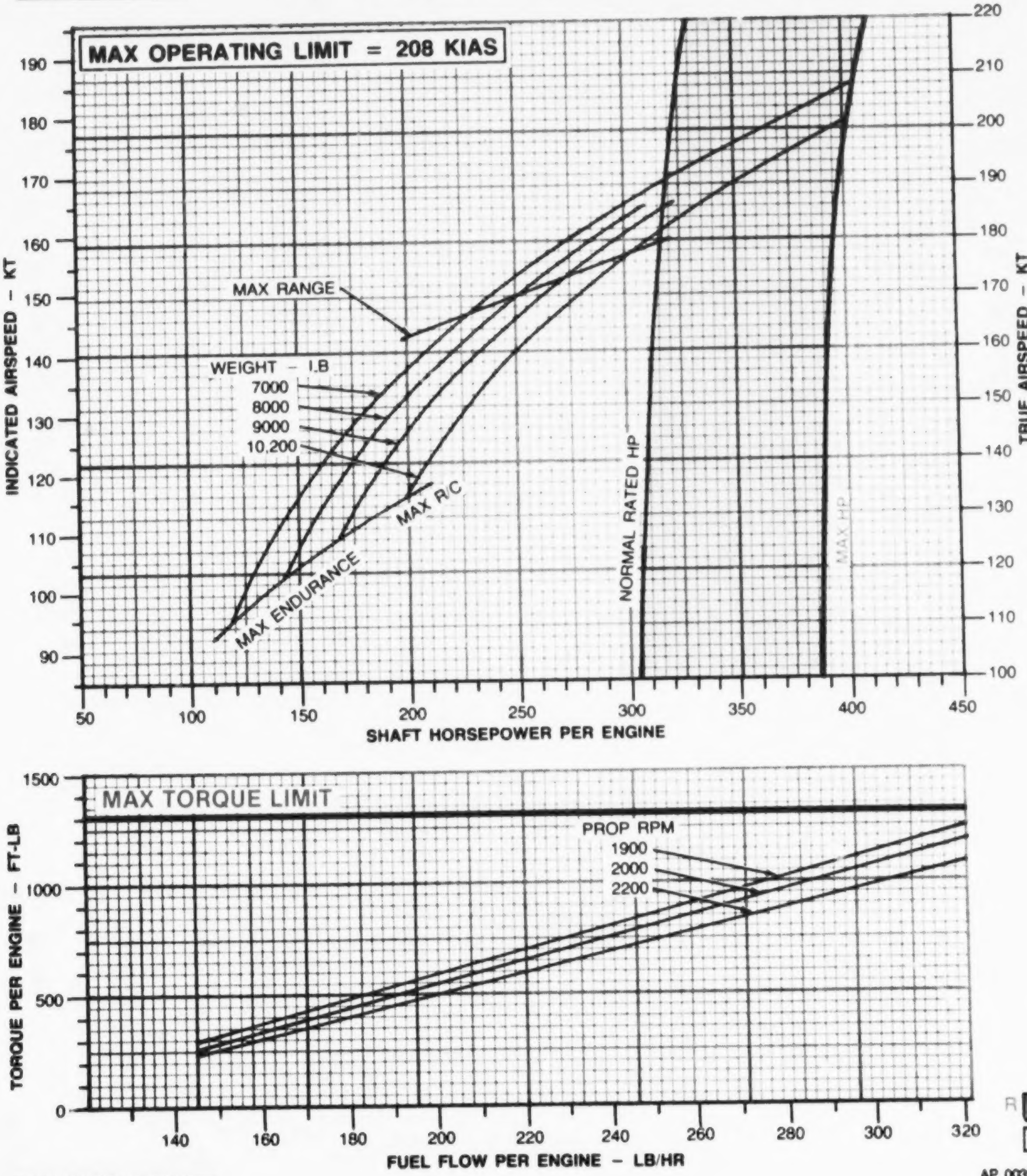
Figure 7-39. Cruise FAT 30°C, 4000 Ft RU-21A

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 40°C



DATA BASIS: ESTIMATED

AP 003984

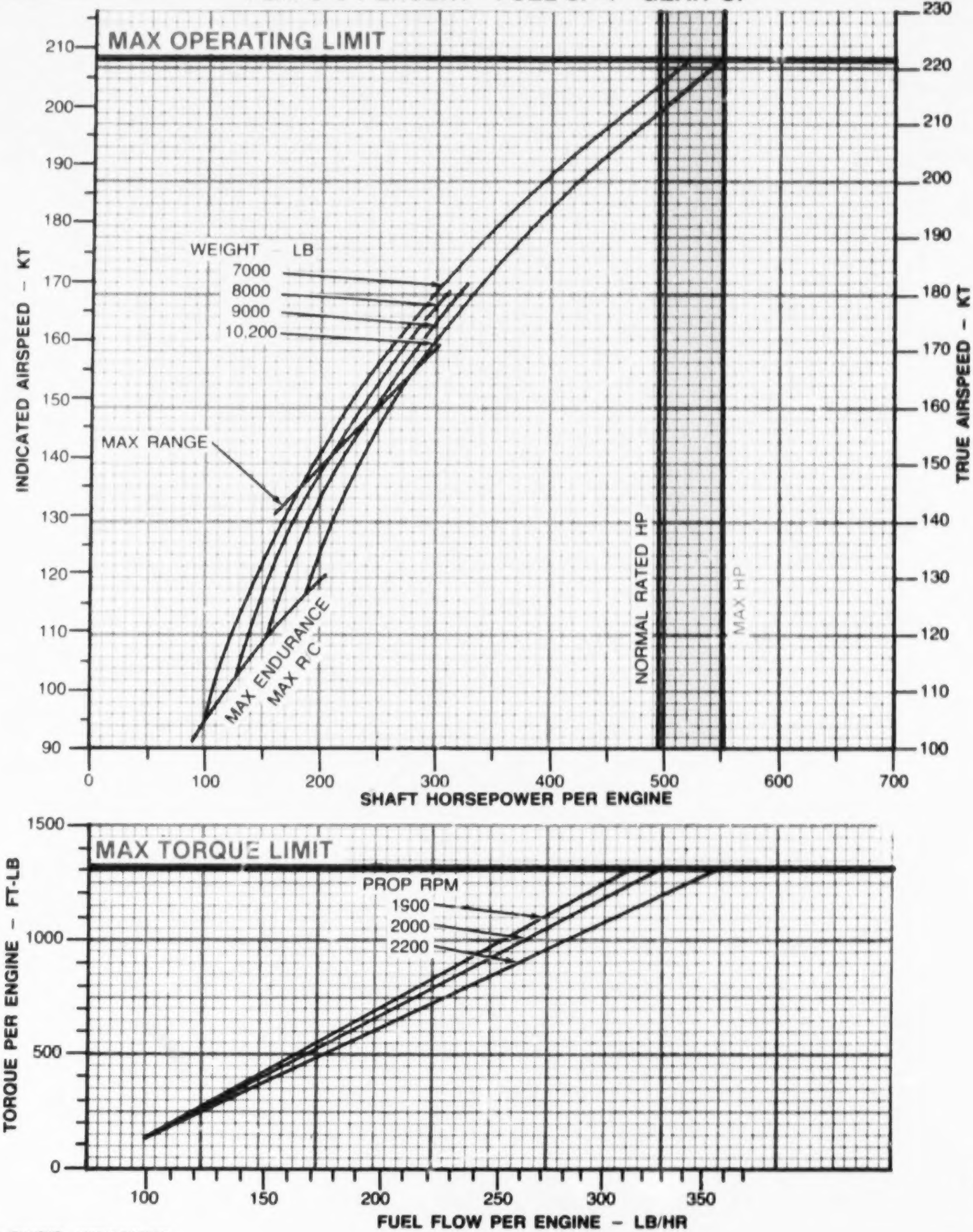
Figure 7-40. Cruise FAT 40°C, 4000 Ft **RU-21A**

CRUISE
RU-21A
T74-CP-700

FAT = −30°C

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP



DATA BASIS: ESTIMATED

R

AP 003985.1

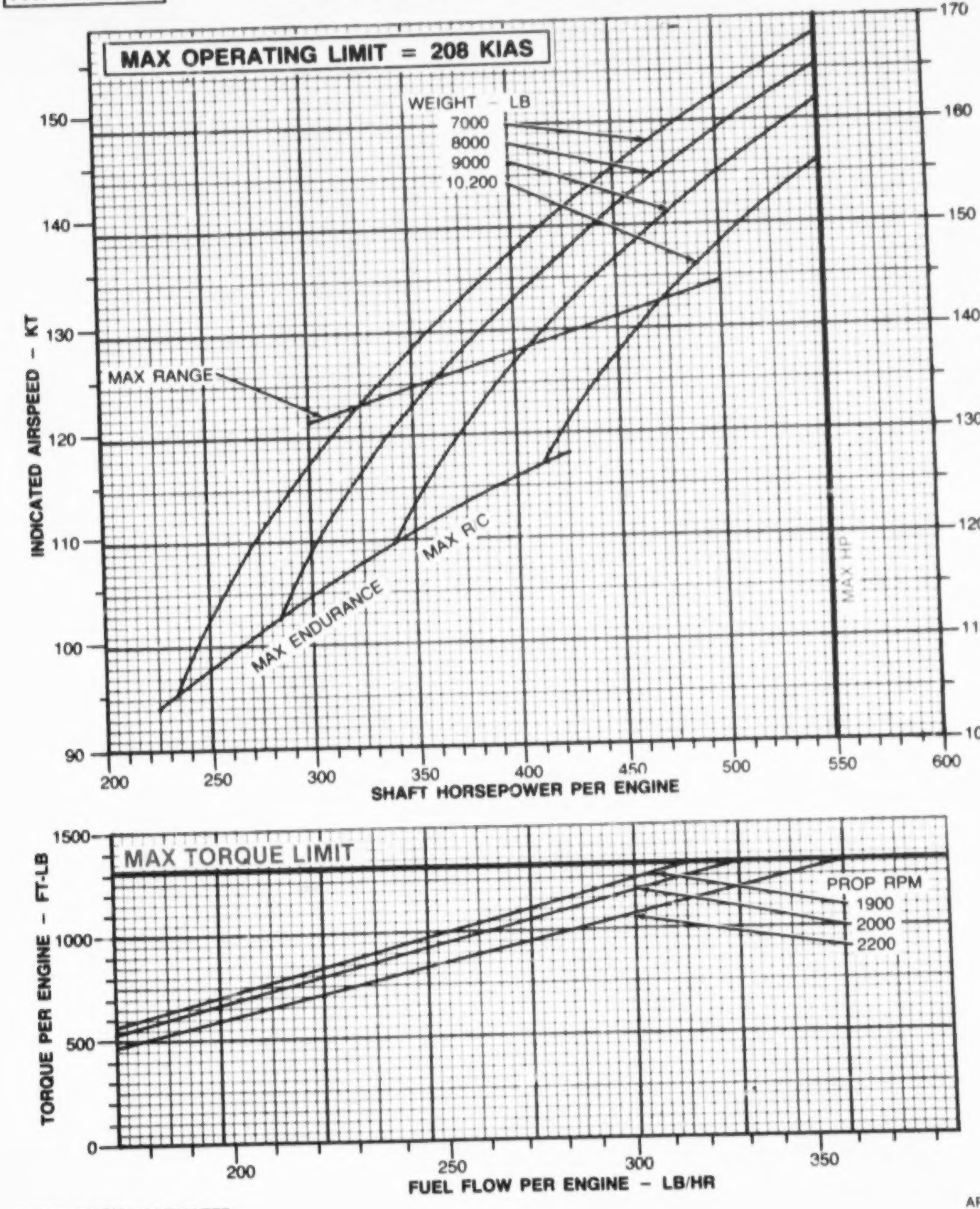
Figure 7-41. Cruise FAT −30°C, 8000 Ft **RU-21A** *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21A
T74-CP-700

SINGLE ENGINE
PRESSURE ALITITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



R

AP 003985.2

DATA BASIS: ESTIMATED

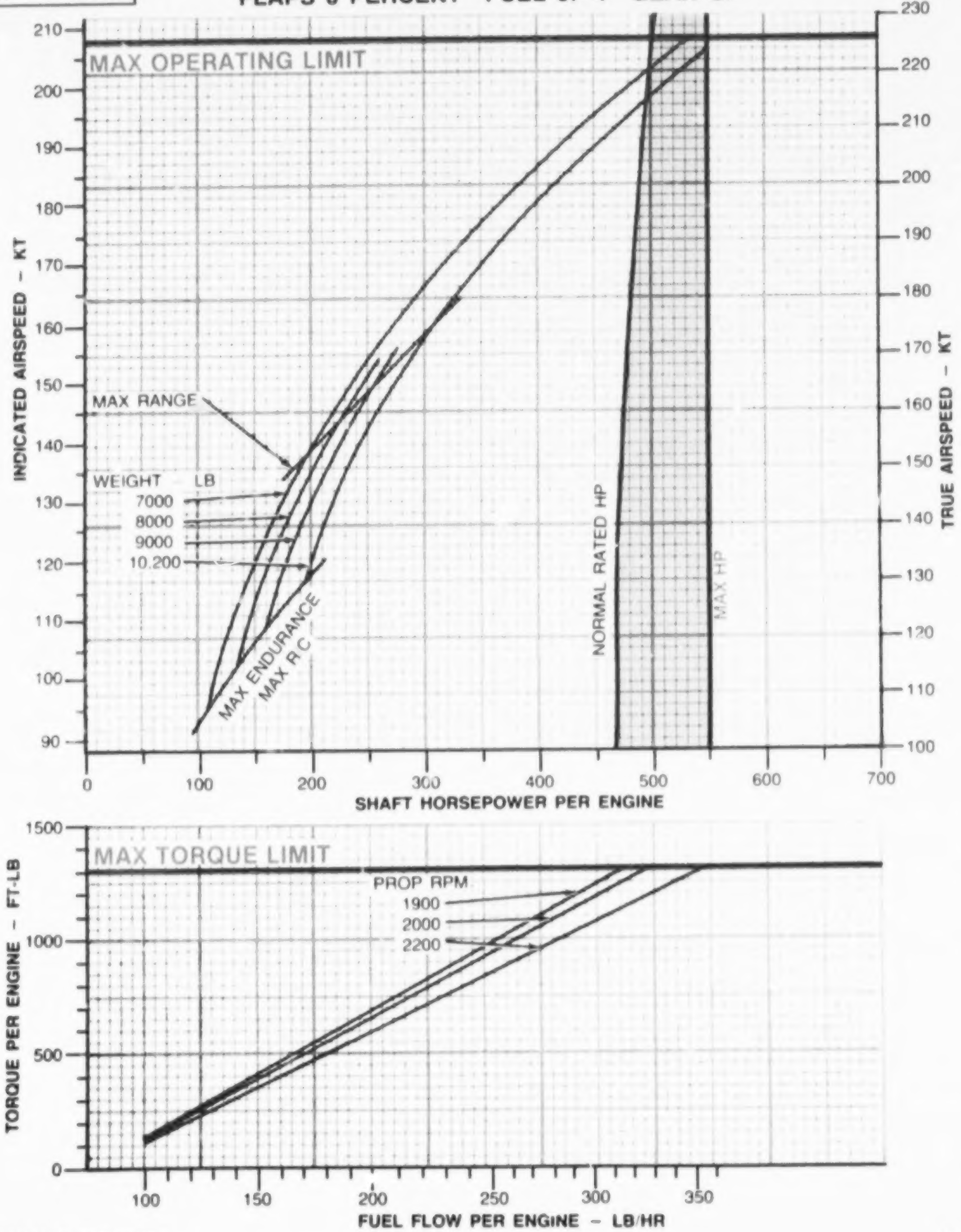
Figure 7-41. Cruise FAT −30°C, 8000 Ft **RU-21A** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C

CRUISE
RU-21A
T74-CP-700



DATA BASIS: ESTIMATED

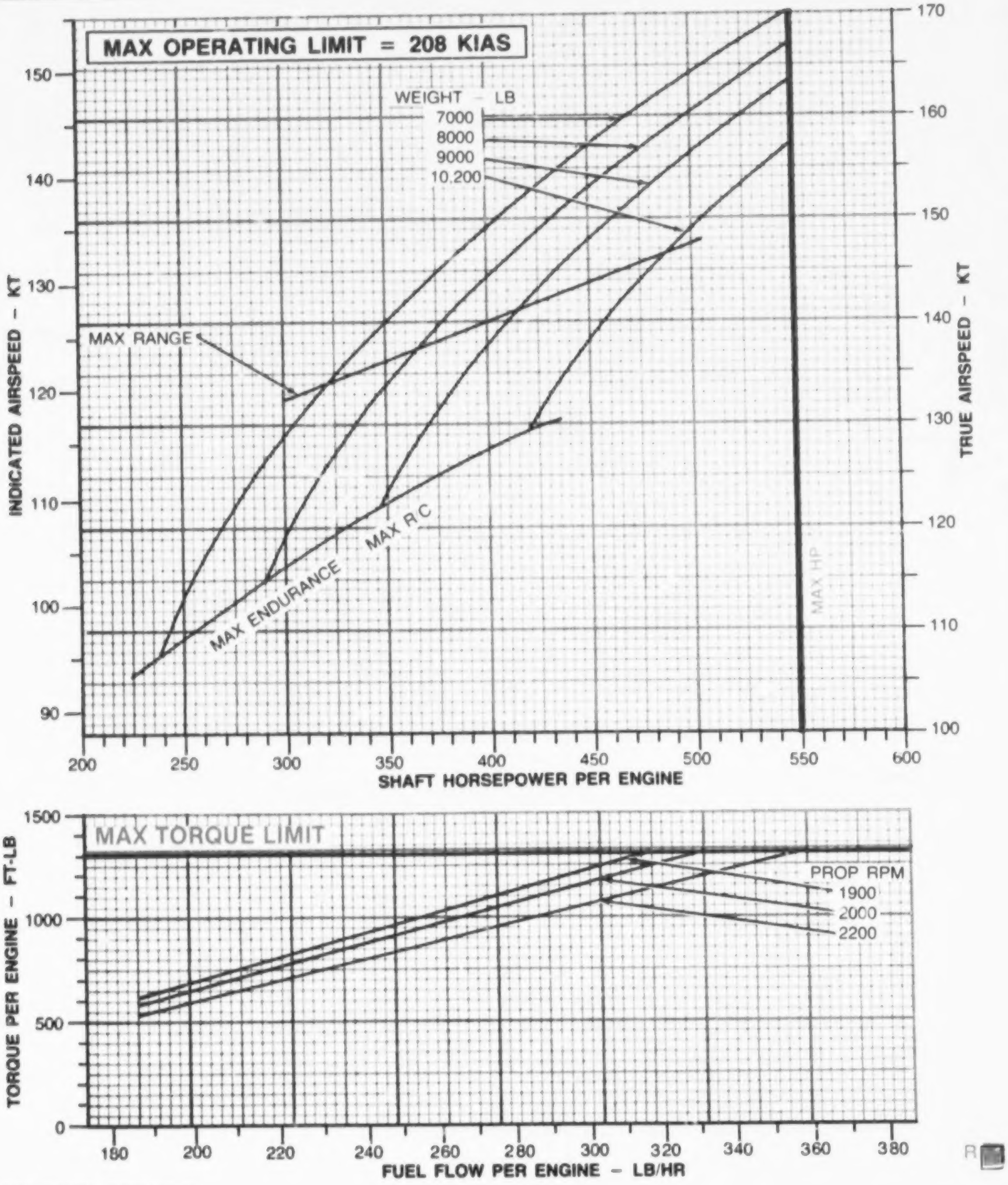
AP 004282 1

Figure 7-42. Cruise FAT −20°C, 8000 Ft **RU-21A** *(Sheet 1 of 2)*

CRUISE

SINGLE ENGINE
PRESSURE ALITITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C



DATA BASIS: ESTIMATED

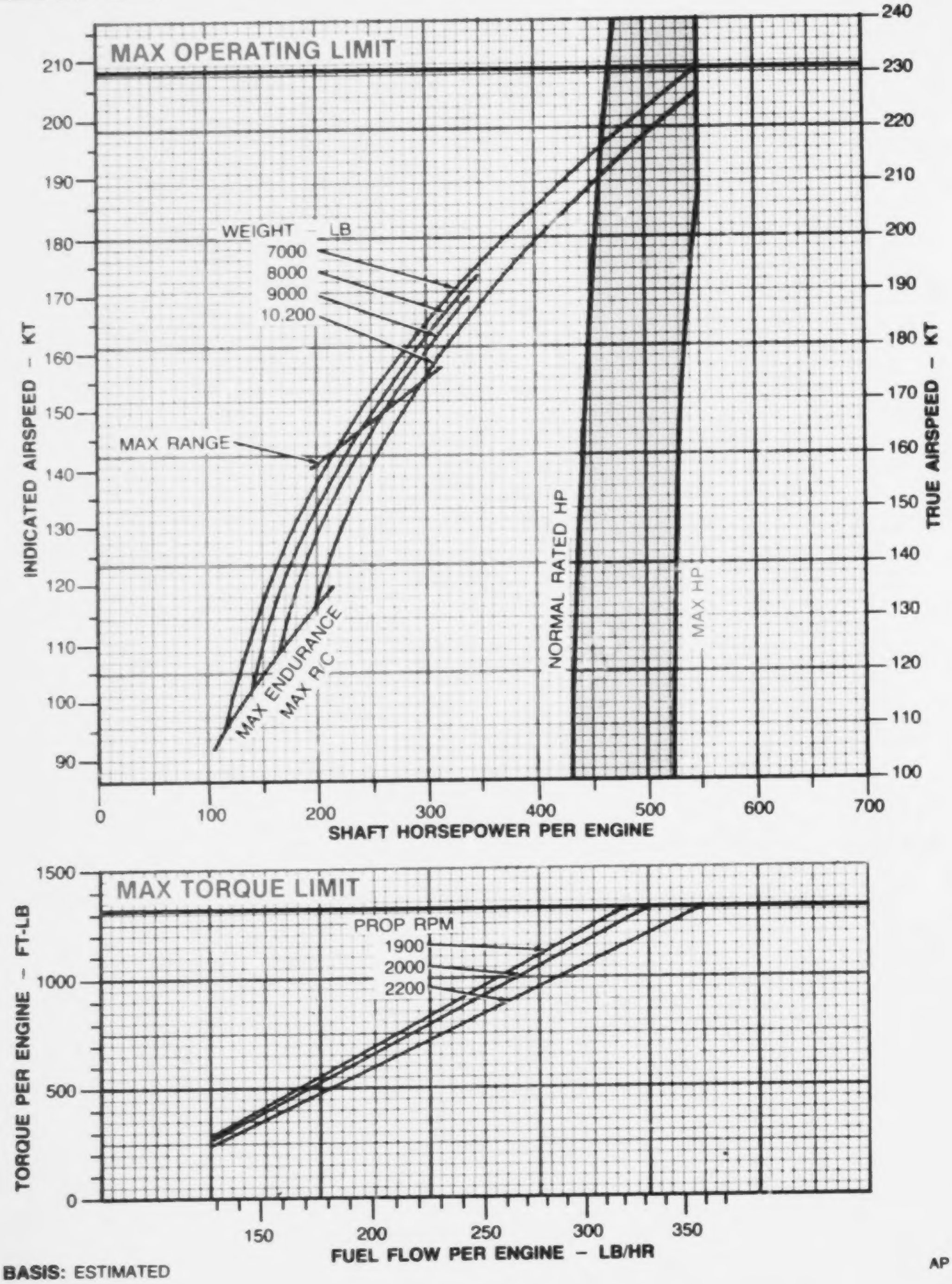
Figure 7-42. Cruise FAT −20°C, 8000 Ft **RU-21A** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21A
T74-CP-700

FAT = −10°C



DATA BASIS: ESTIMATED

AP 003986.1

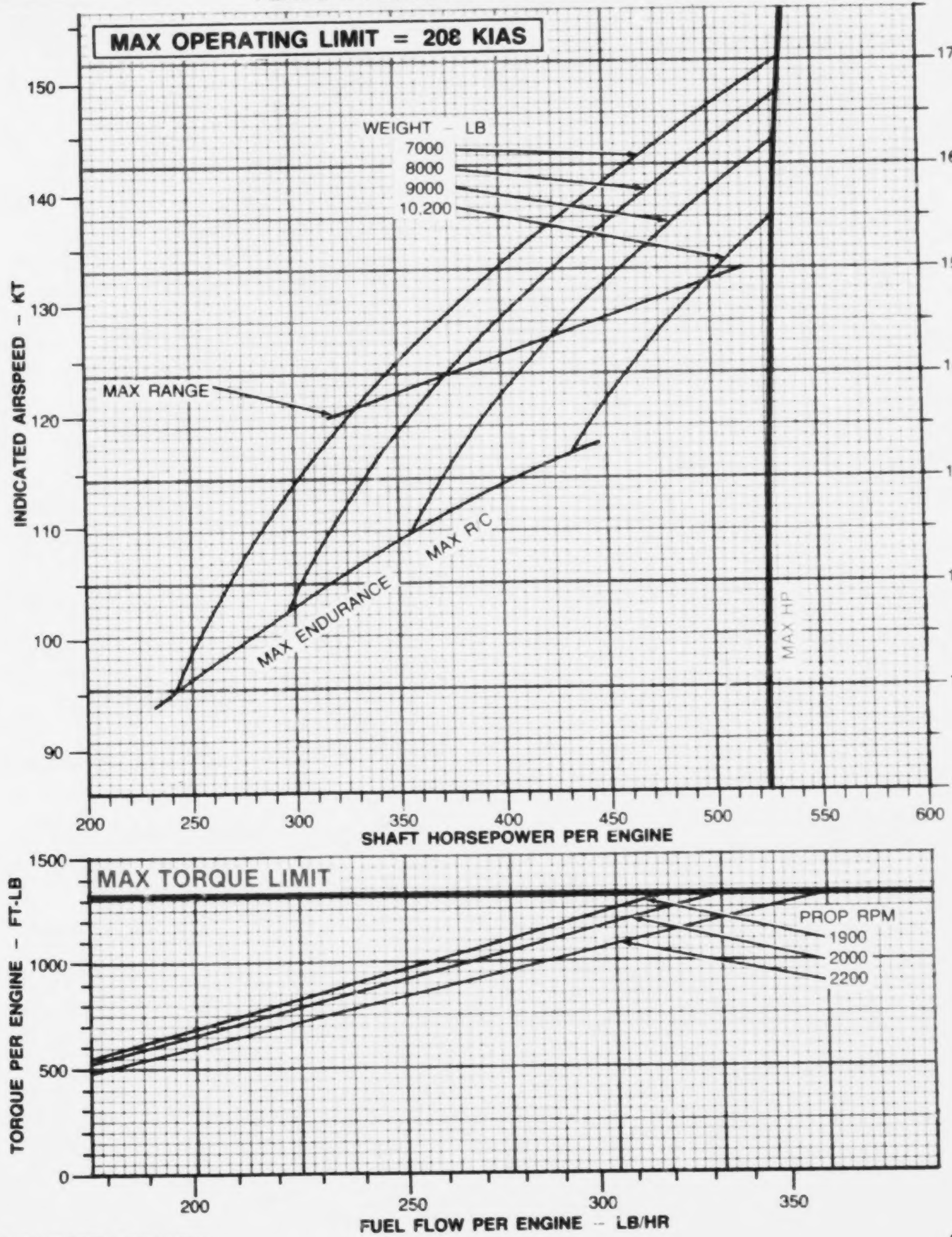
Figure 7-43. Cruise FAT −10°C, 8000 Ft **RU-21A** *(Sheet 1 of 2)*

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C

CRUISE
RU-21A
T74-CP-700



DATA BASIS: ESTIMATED

R

AP 003986.2

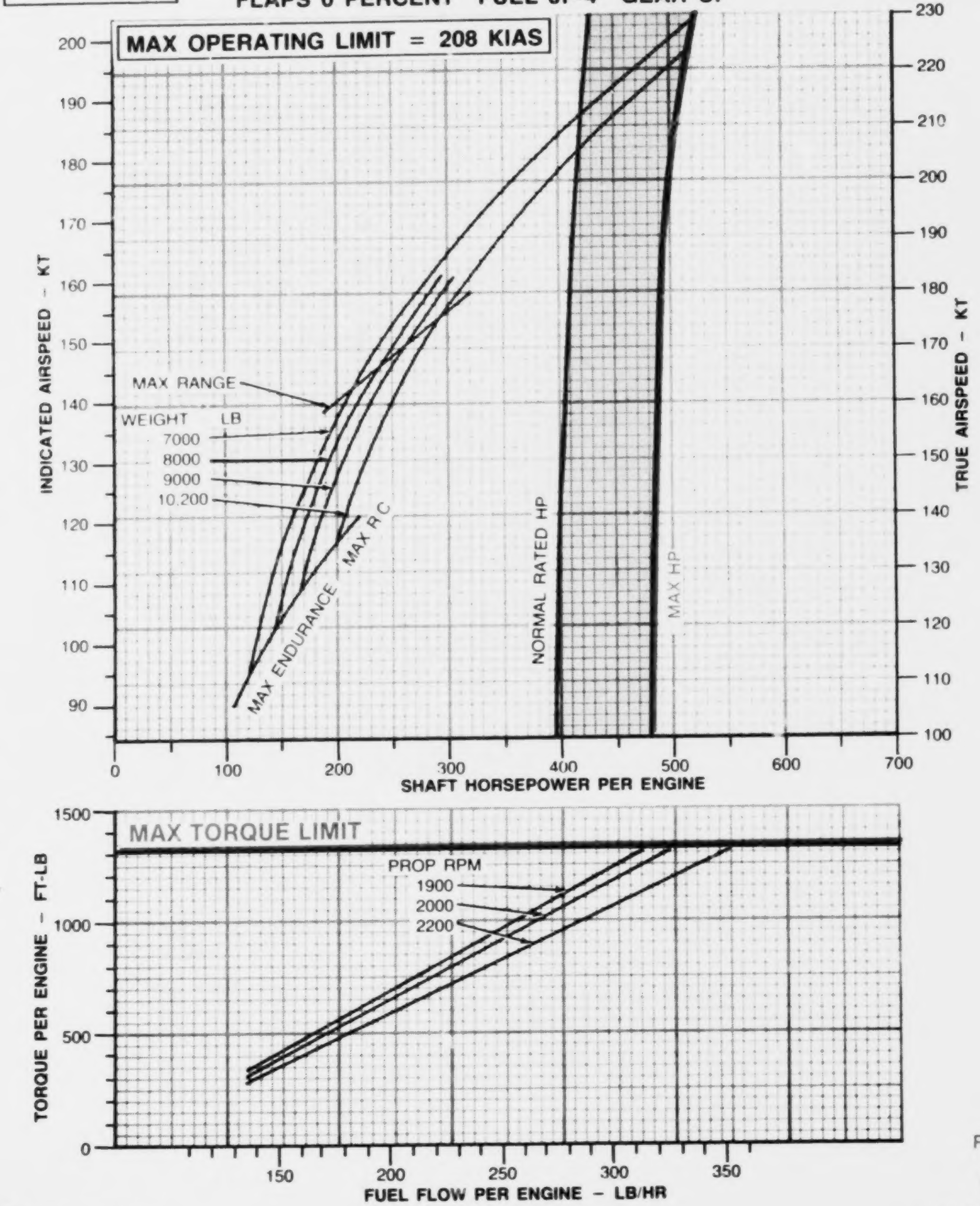
Figure 7-43. Cruise FAT −10°C, 8000 Ft **RU-21A** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21A
T74-CP-700

FAT = 0°C



DATA BASIS: ESTIMATED

AP 004283.1

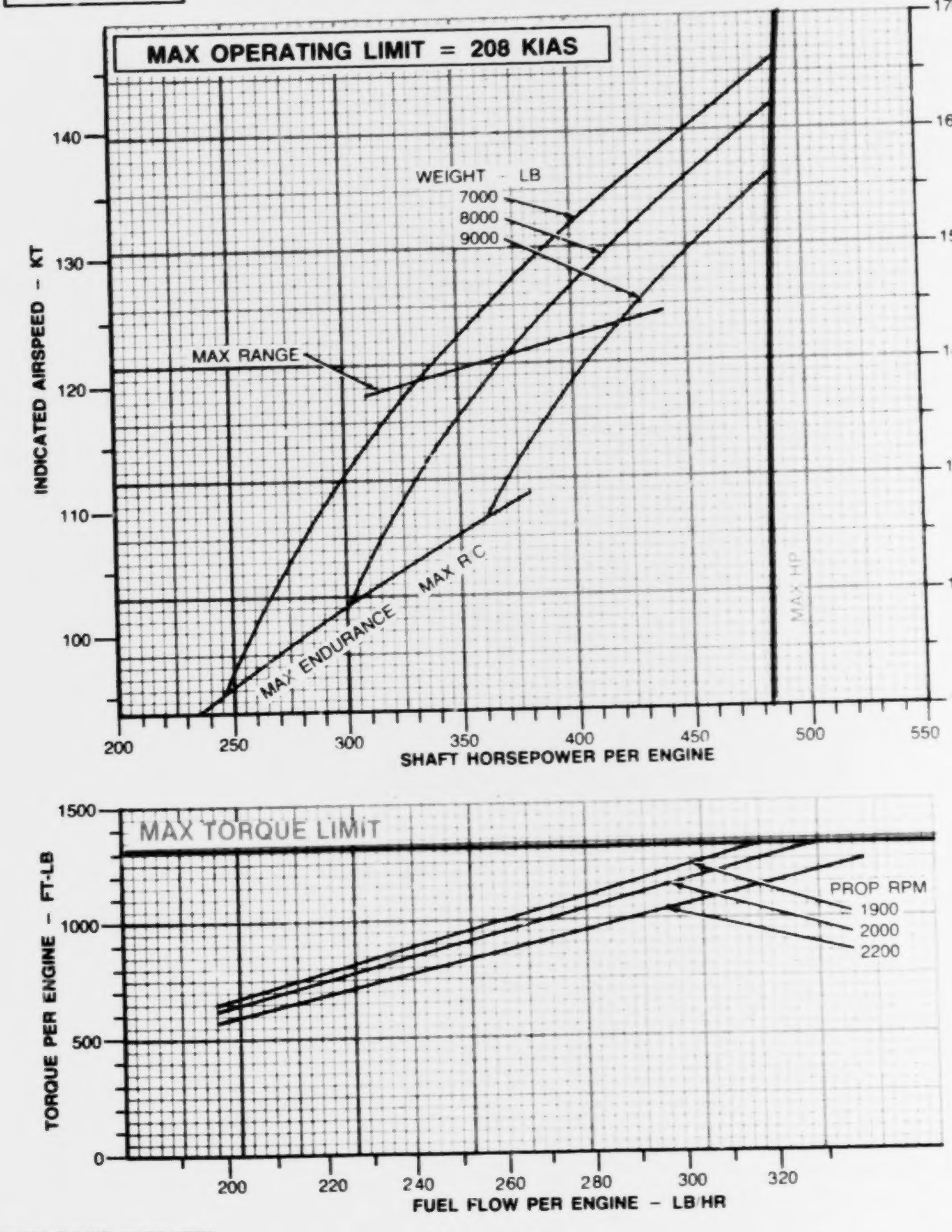
Figure 7-44. Cruise FAT 0°C, 8000 Ft **RU-21A** *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21A
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

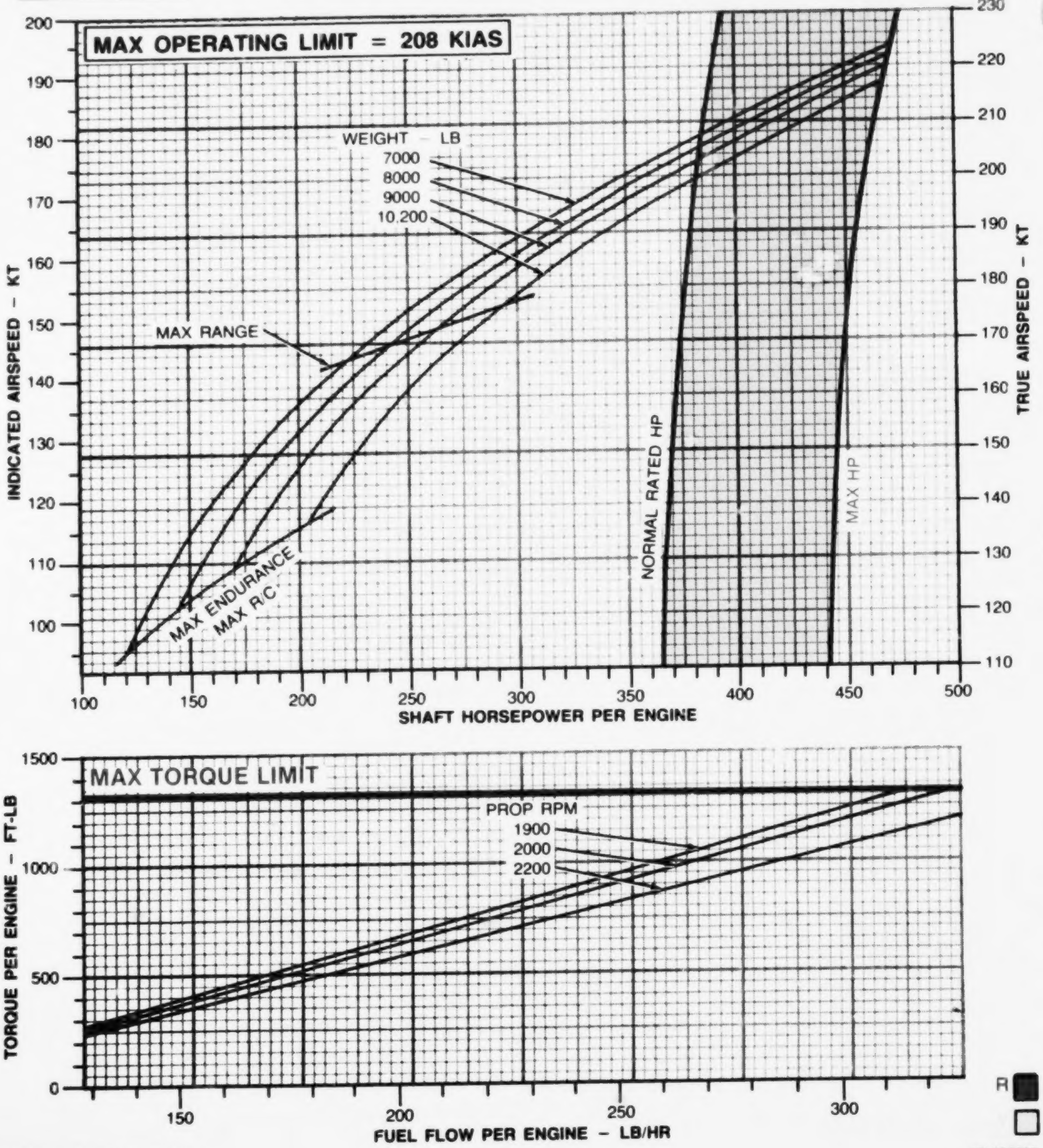
Figure 7-44. Cruise FAT 0°C, 8000 Ft **RU-21A** *(Sheet 2 of 2)*

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



DATA BASIS: ESTIMATED

AP 003987

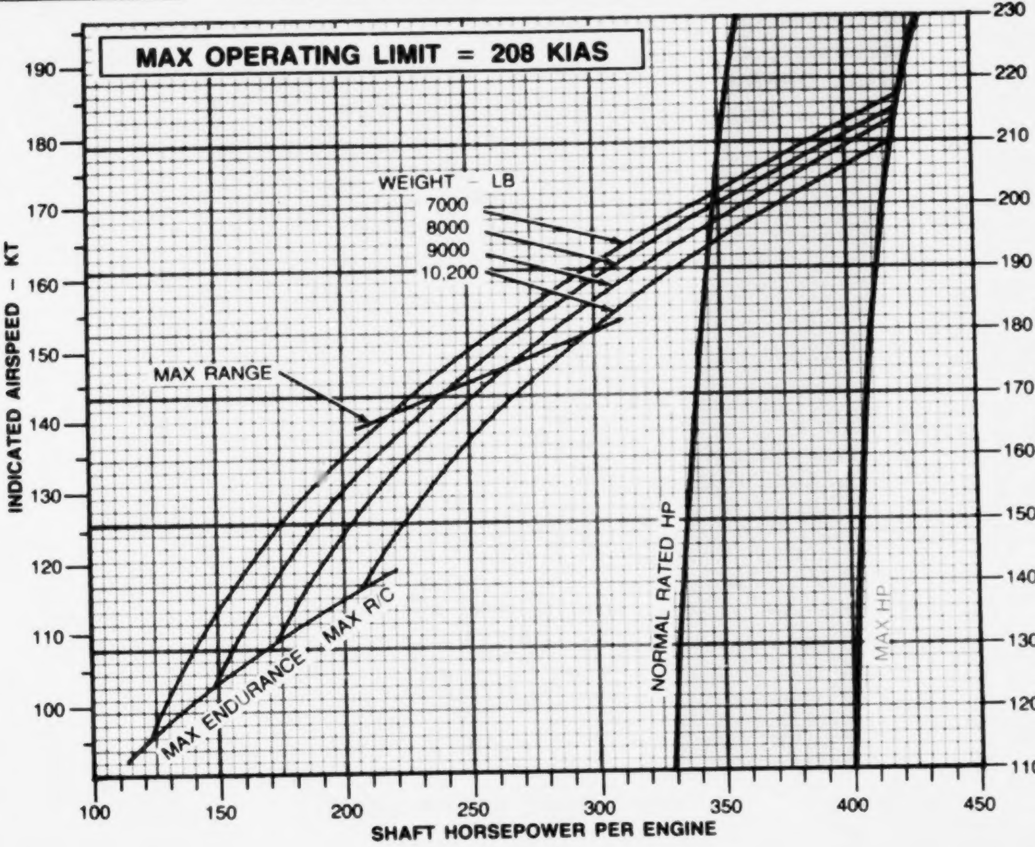
Figure 7-45. Cruise FAT 10°C, 8000 Ft **RU-21A**

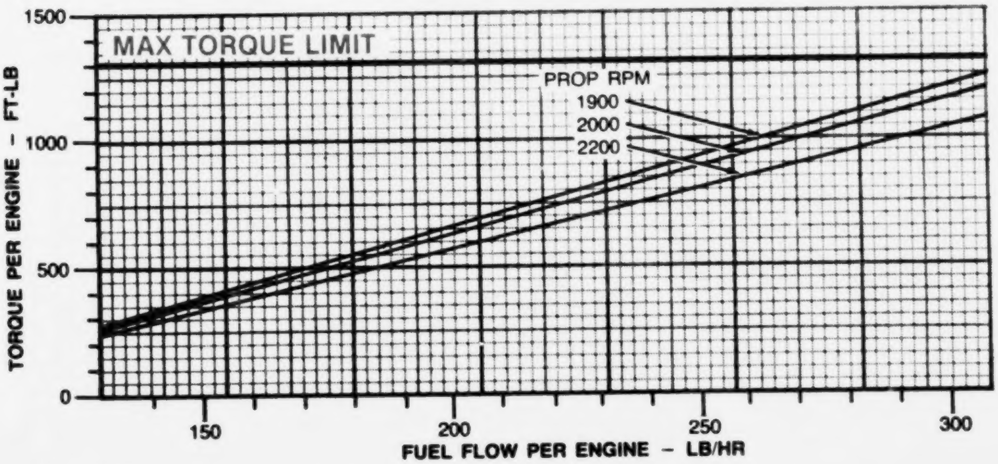
CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C





DATA BASIS: ESTIMATED

AP 004284

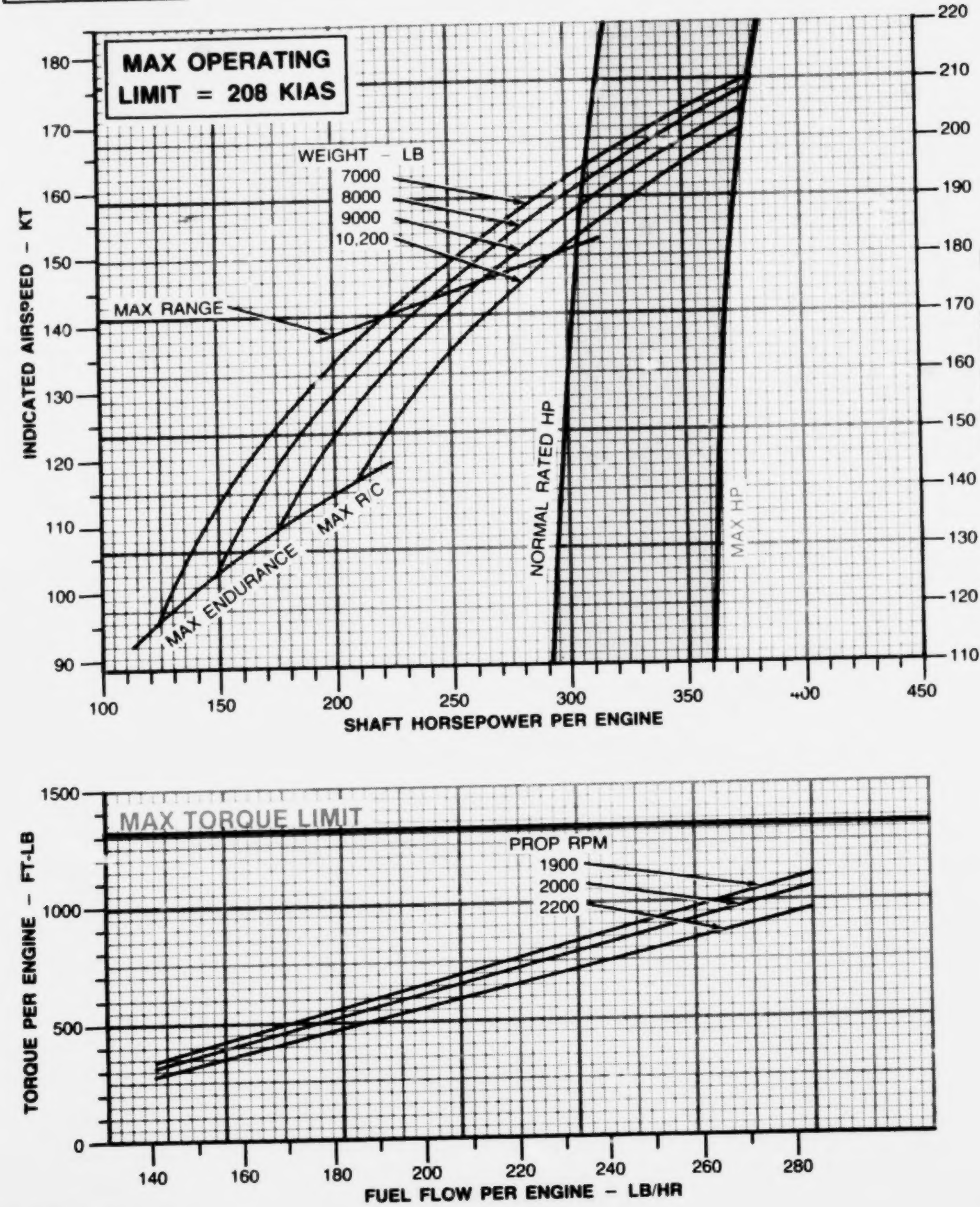
Figure 7-46. Cruise FAT 20°C, 8000 Ft RU-21A

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 30°C



DATA BASIS: ESTIMATED

AP 003988

Figure 7-47. Cruise FAT 30°C, 8000 Ft **RU-21A**

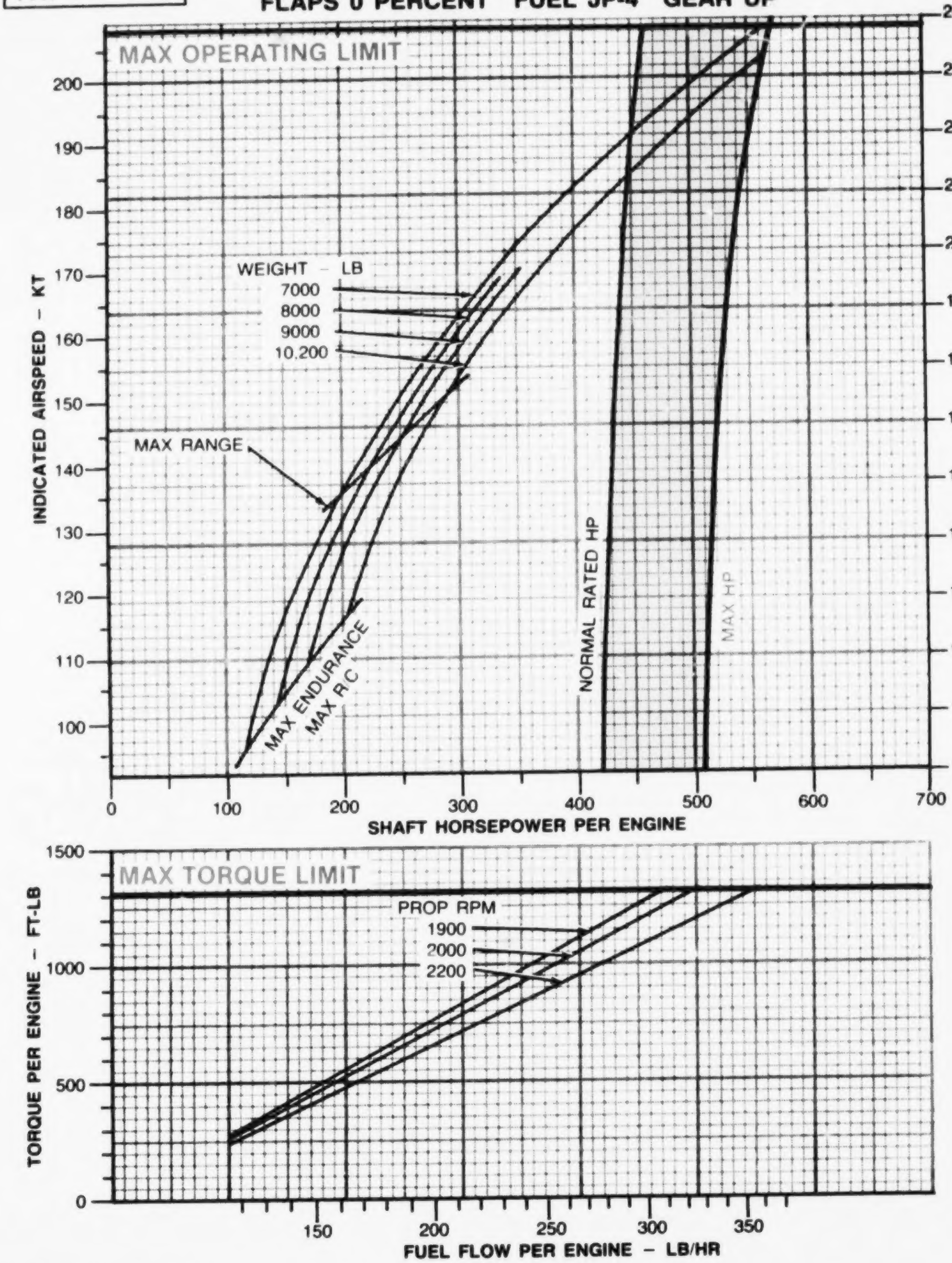
(7-95 blank)

CRUISE
RU-21A
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



DATA BASIS: ESTIMATED

AP 003989.1

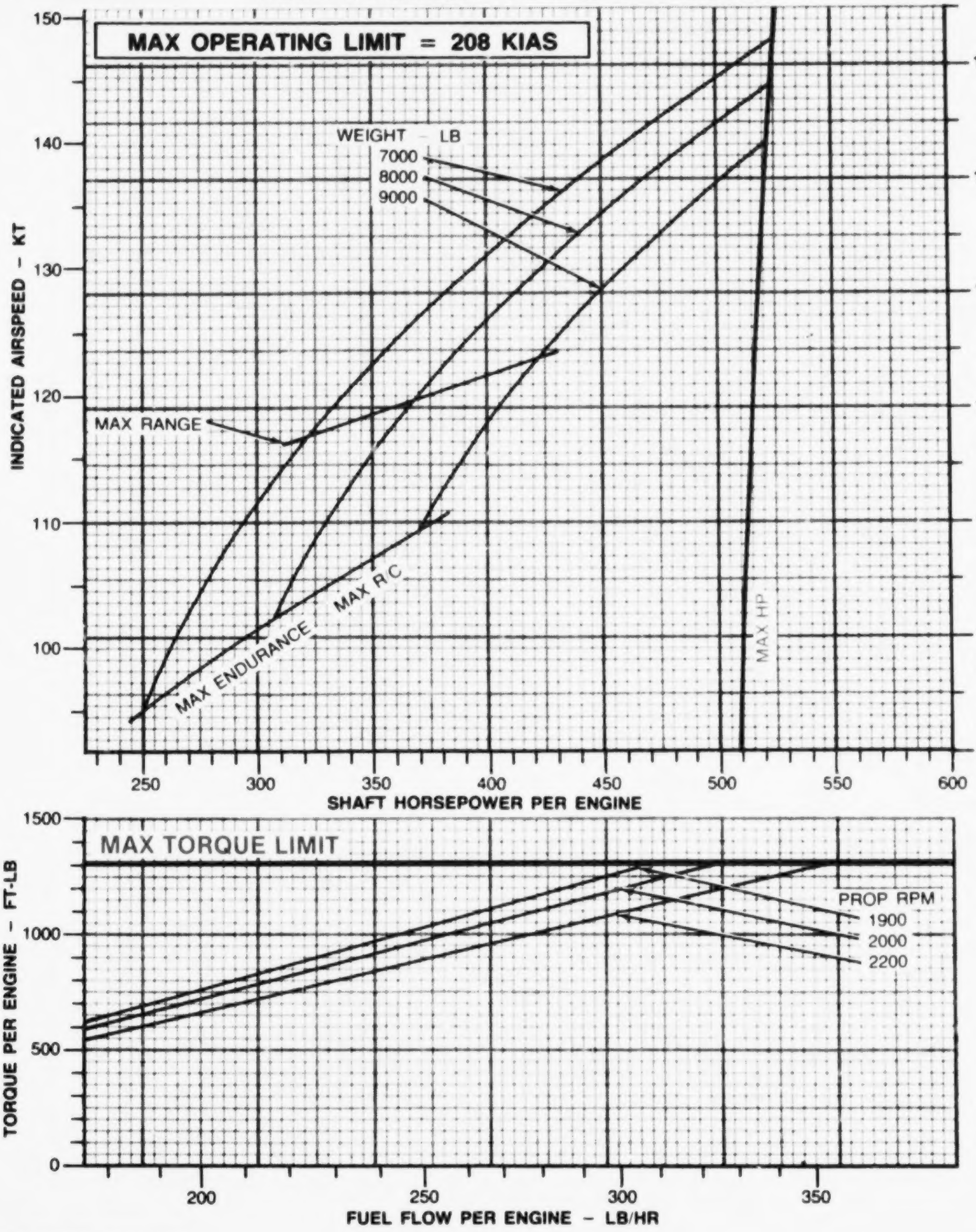
Figure 7-48. Cruise FAT −30°C, 12,000 Ft RU-21A *(Sheet 1 of 2)*

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C

CRUISE
RU-21A
T74-CP-700



DATA BASIS: ESTIMATED

AP 003989 2

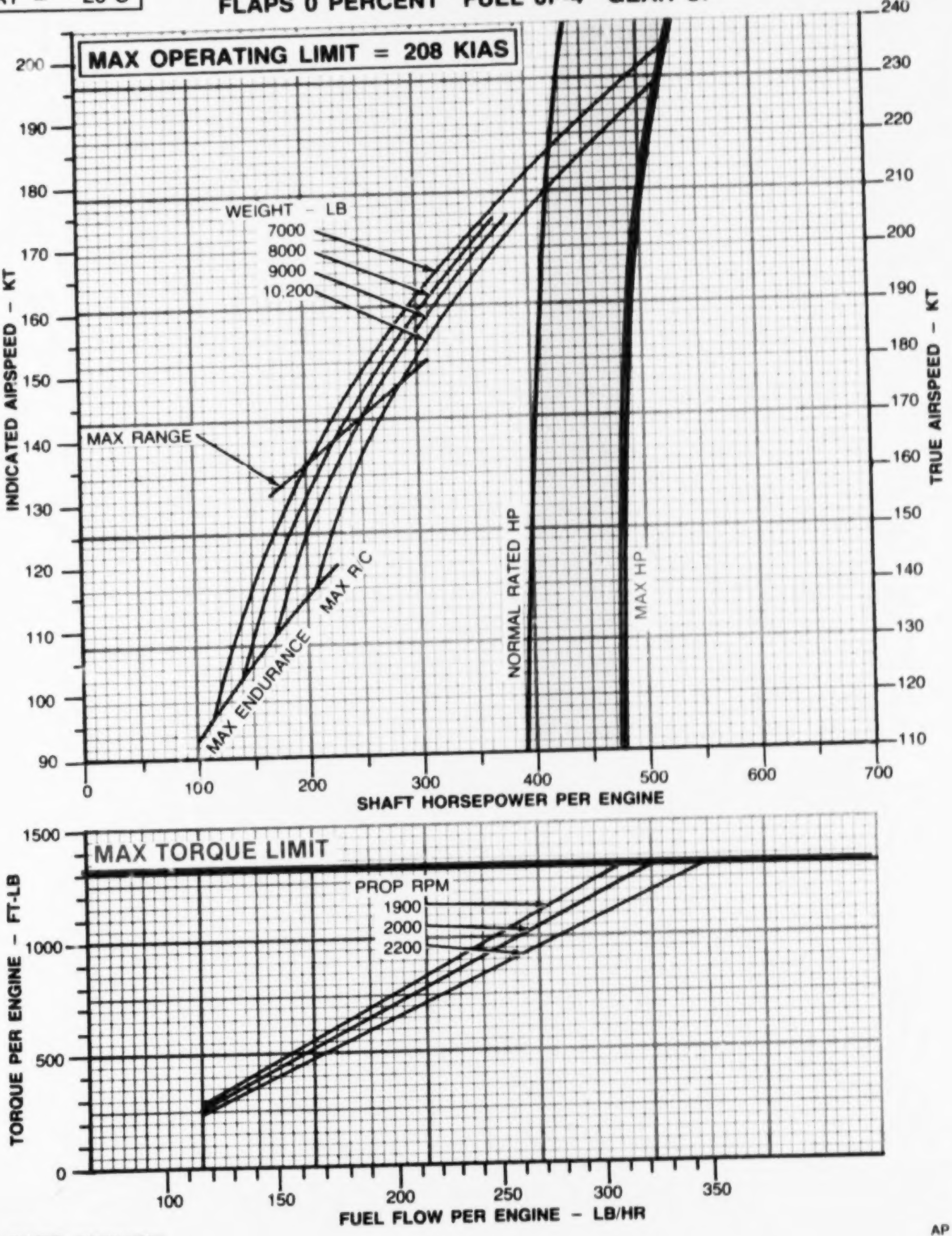
Figure 7-48. Cruise FAT −30°C, 12,000 Ft **RU-21A** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21A
T74-CP-700

FAT = −20°C



DATA BASIS: ESTIMATED

R

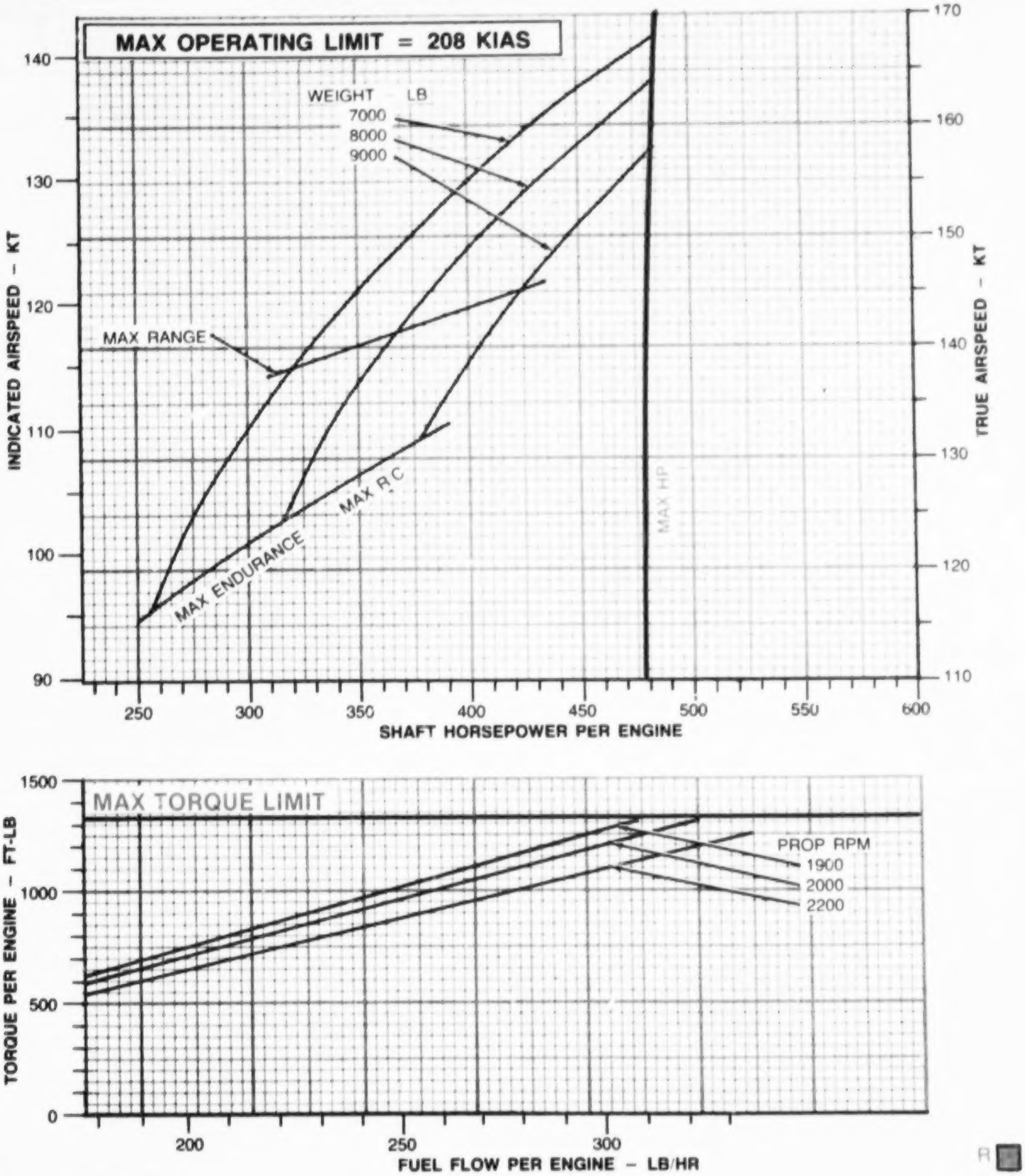
AP 004285.1

Figure 7-49. Cruise FAT −20°C, 12,000 Ft **RU-21A** *(Sheet 1 of 2)*

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C



DATA BASIS: ESTIMATED

R

AP 004285.2

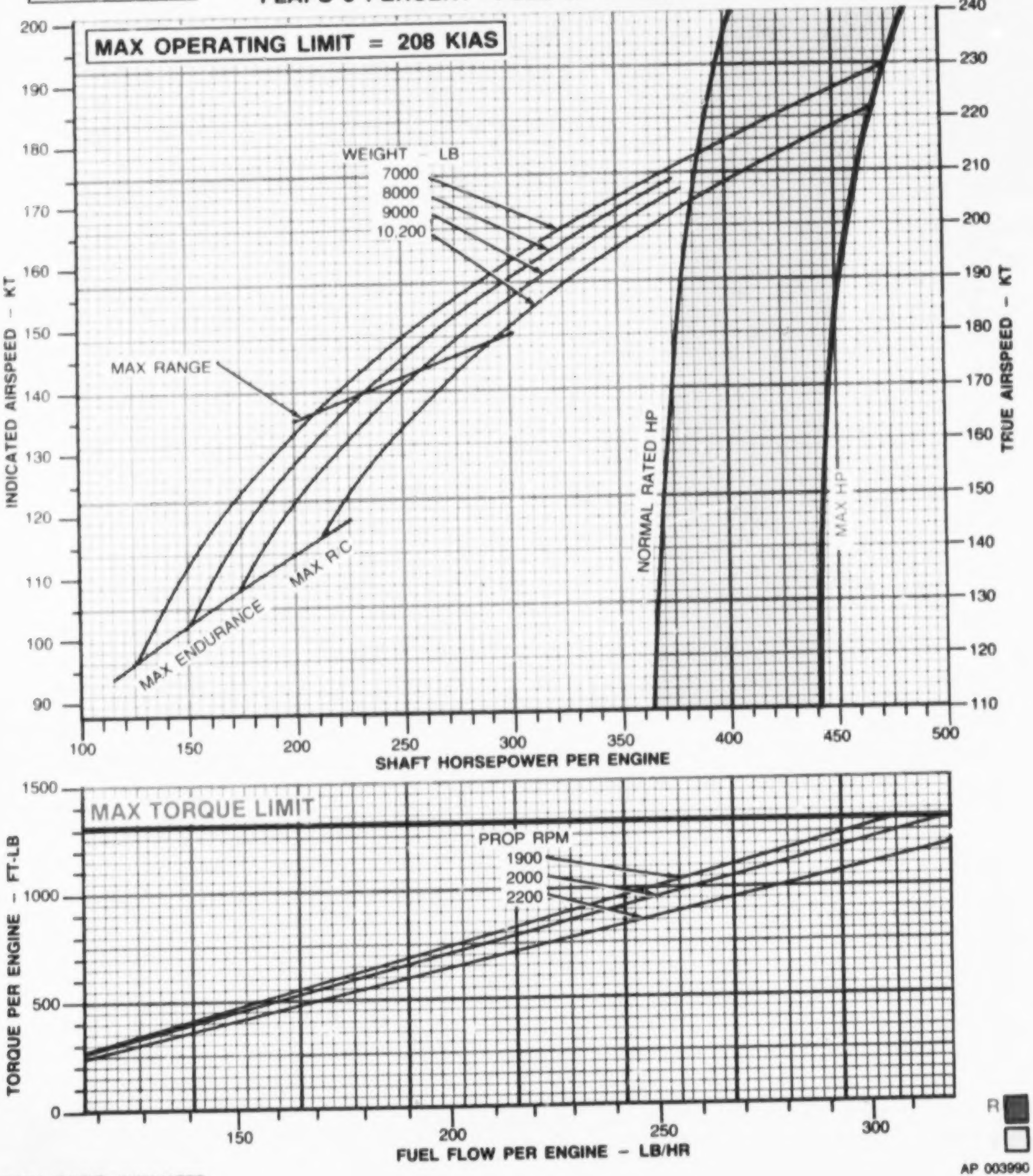
Figure 7-49. Cruise FAT −20°C, 12,000 Ft **RU-21A** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21A
T74-CP-700

FAT = −10°C



DATA BASIS: ESTIMATED

AP 003990

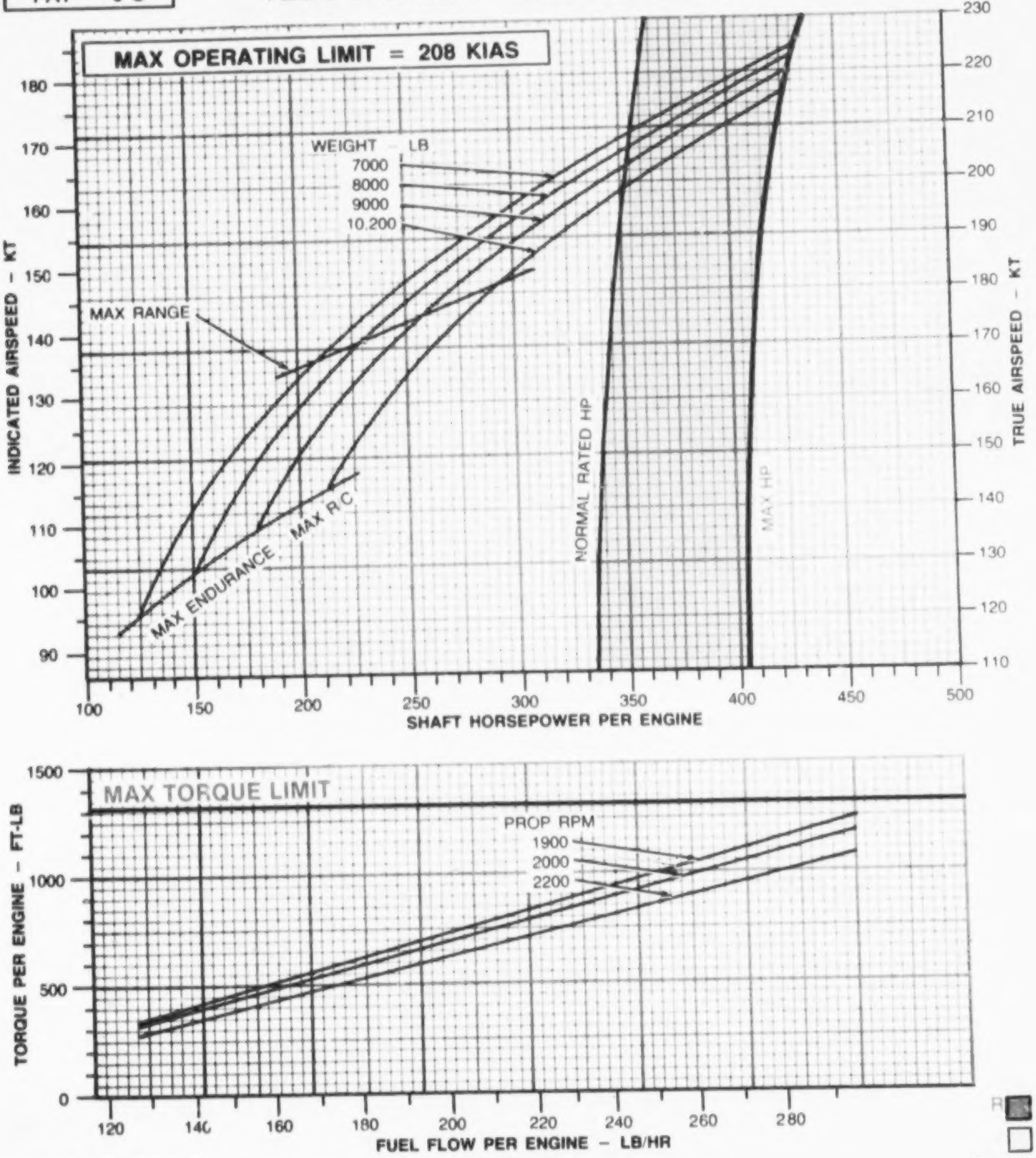
Figure 7-50. Cruise FAT −10°C, 12000 Ft **RU-21A**

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

AP 004286

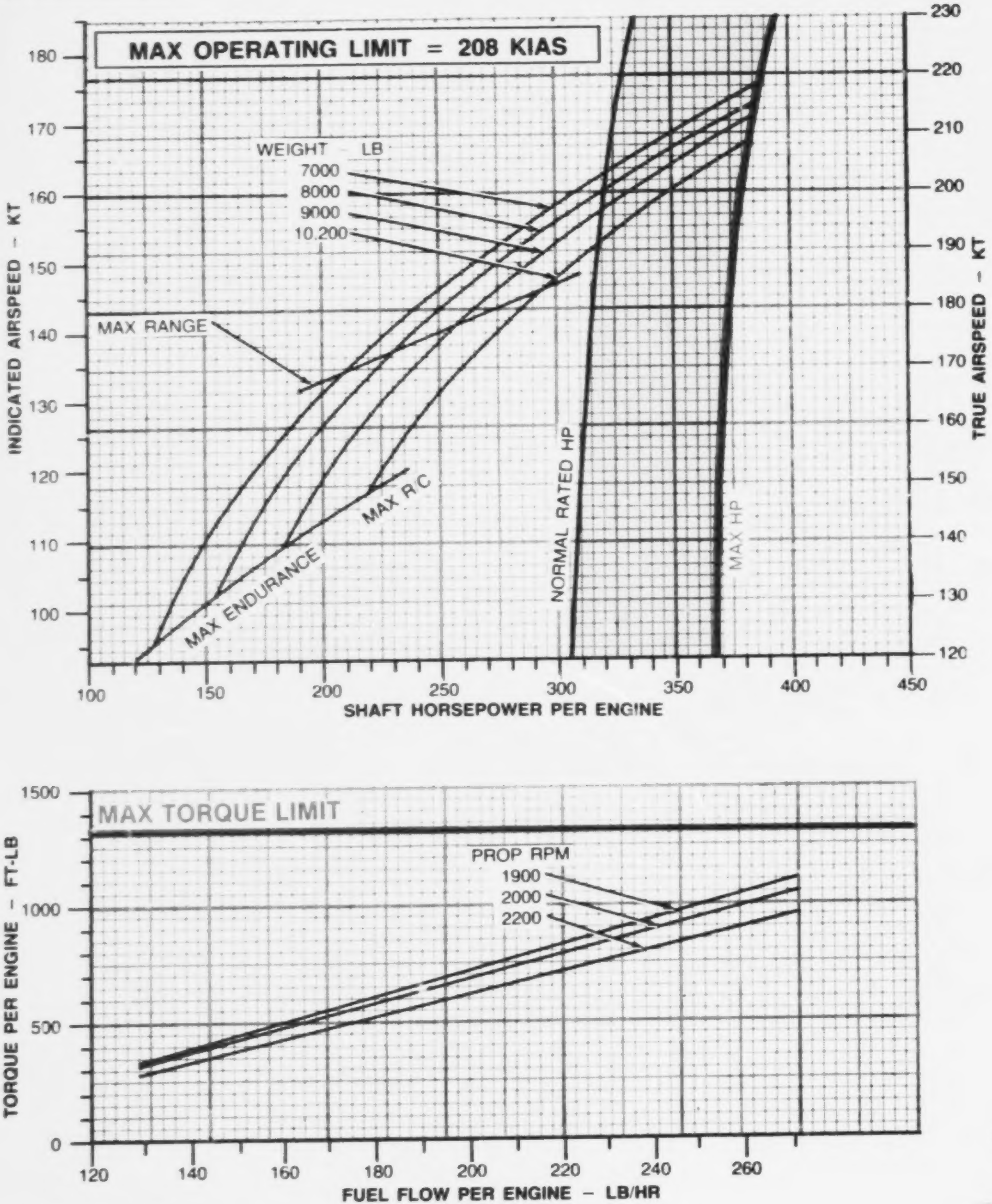
Figure 7-51. Cruise FAT 0°C, 12,000 Ft **RU-21A**

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



DATA BASIS: ESTIMATED

R

AP 003991

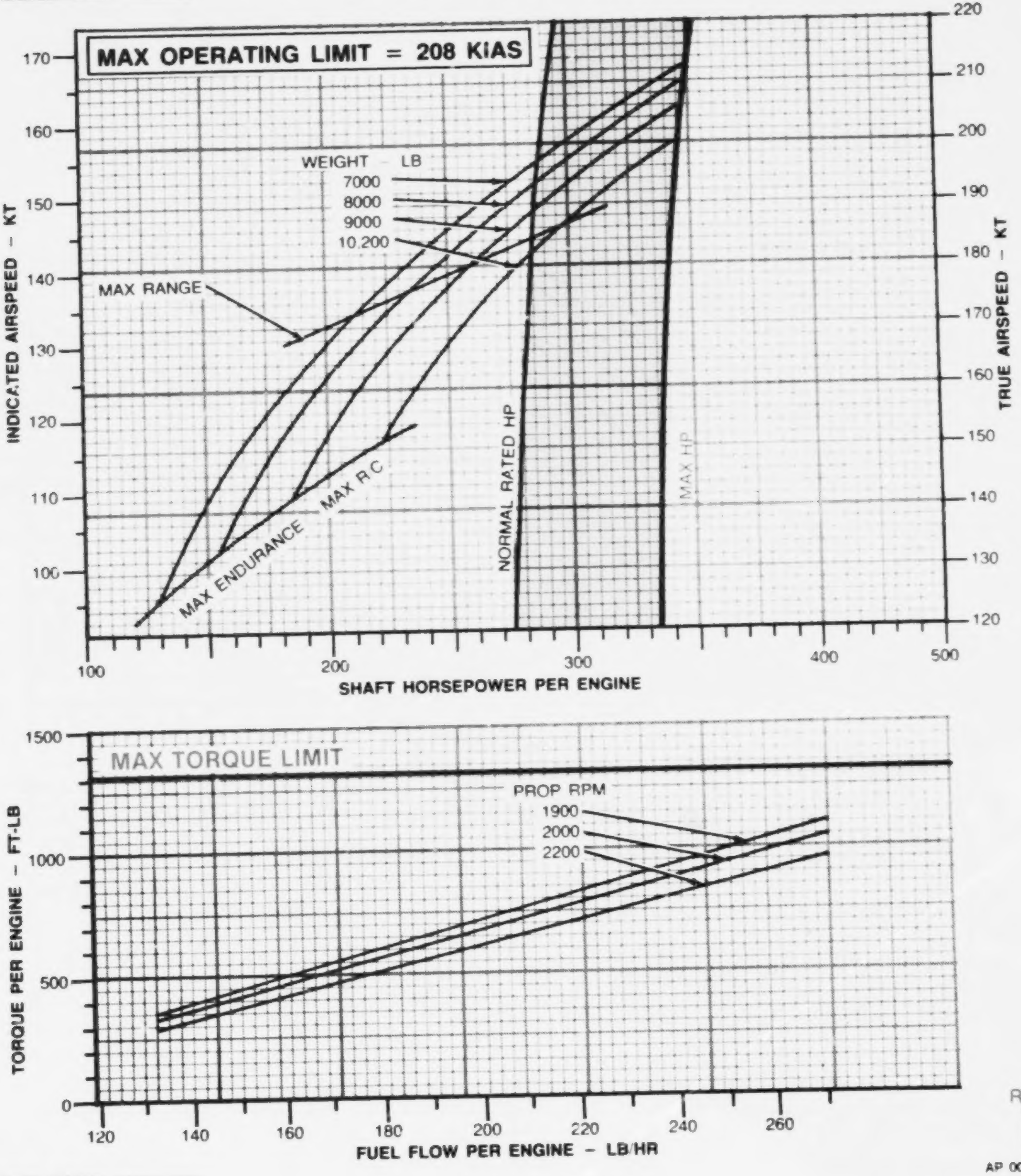
Figure 7-52. Cruise FAT 10°C, 12,000 Ft **RU-21A**

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C



R

AP 004287

DATA BASIS: ESTIMATED

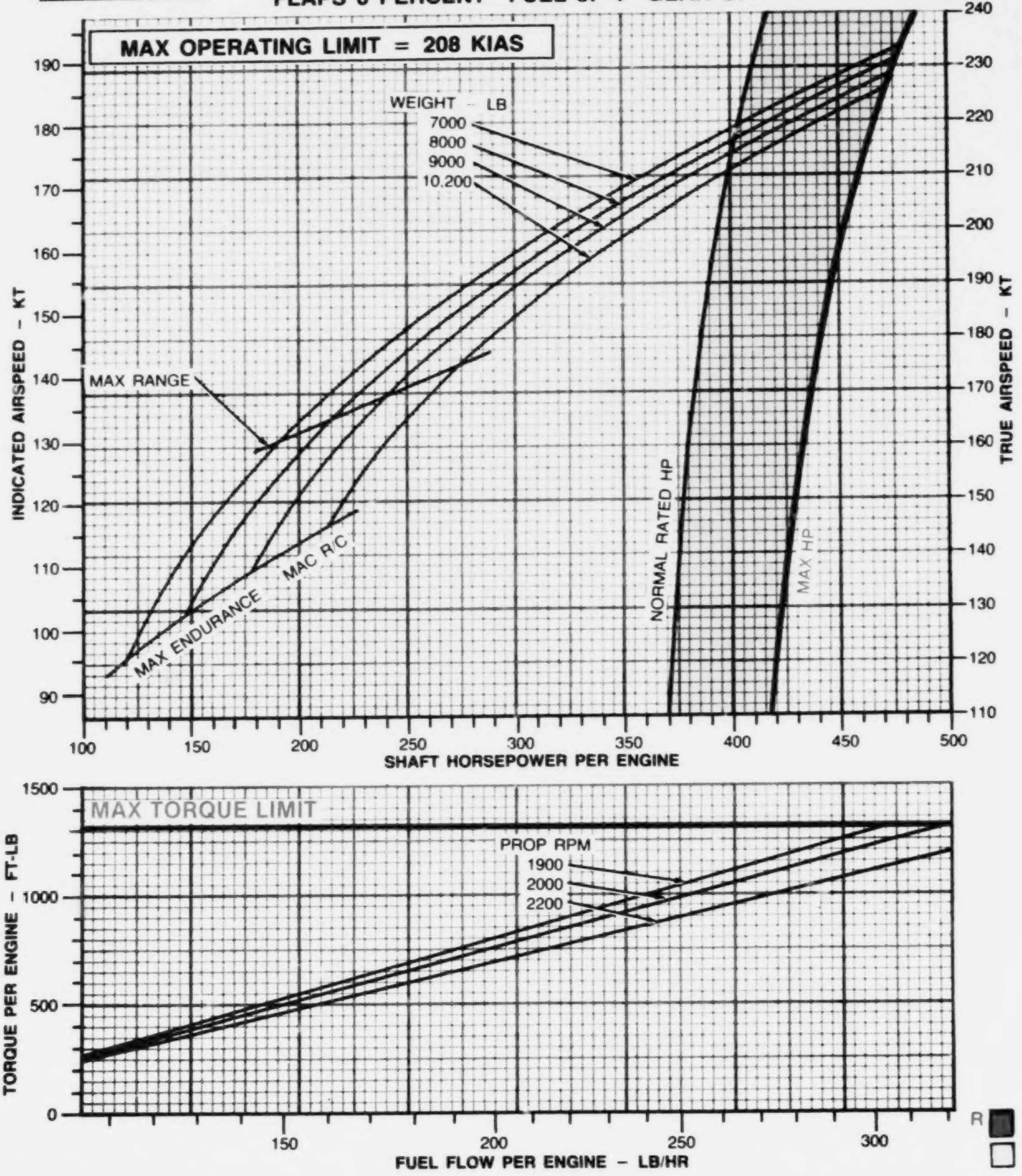
Figure 7-53. Cruise FAT 20°C, 12,000 Ft **RU-21A**

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −40°C

CRUISE
RU-21A
T74-CP-700



DATA BASIS: ESTIMATED

AP 003992

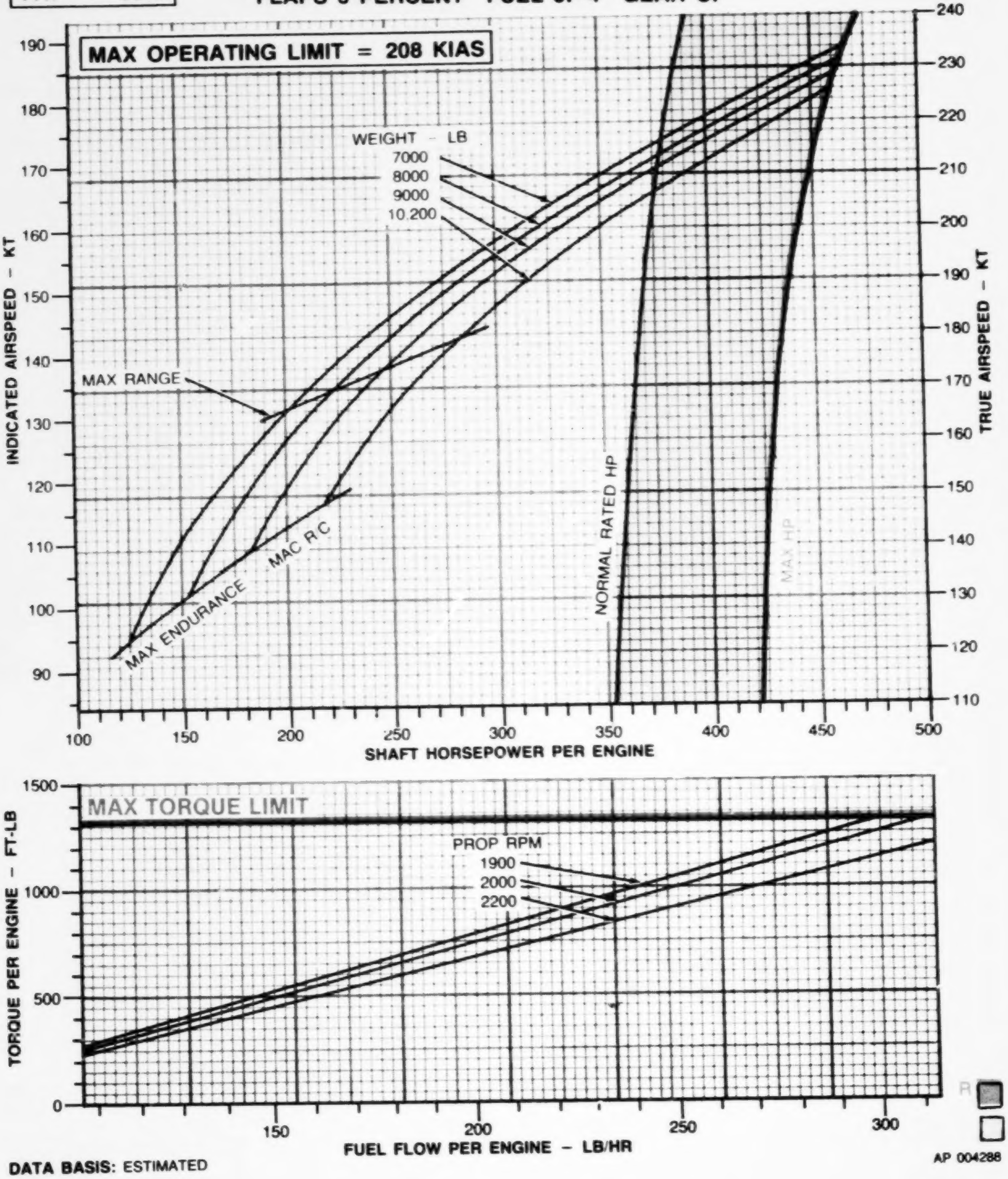
Figure 7-54. Cruise FAT −40°C, 16,000 Ft **RU-21A**

CRUISE
RU-21A
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



DATA BASIS: ESTIMATED

AP 004288

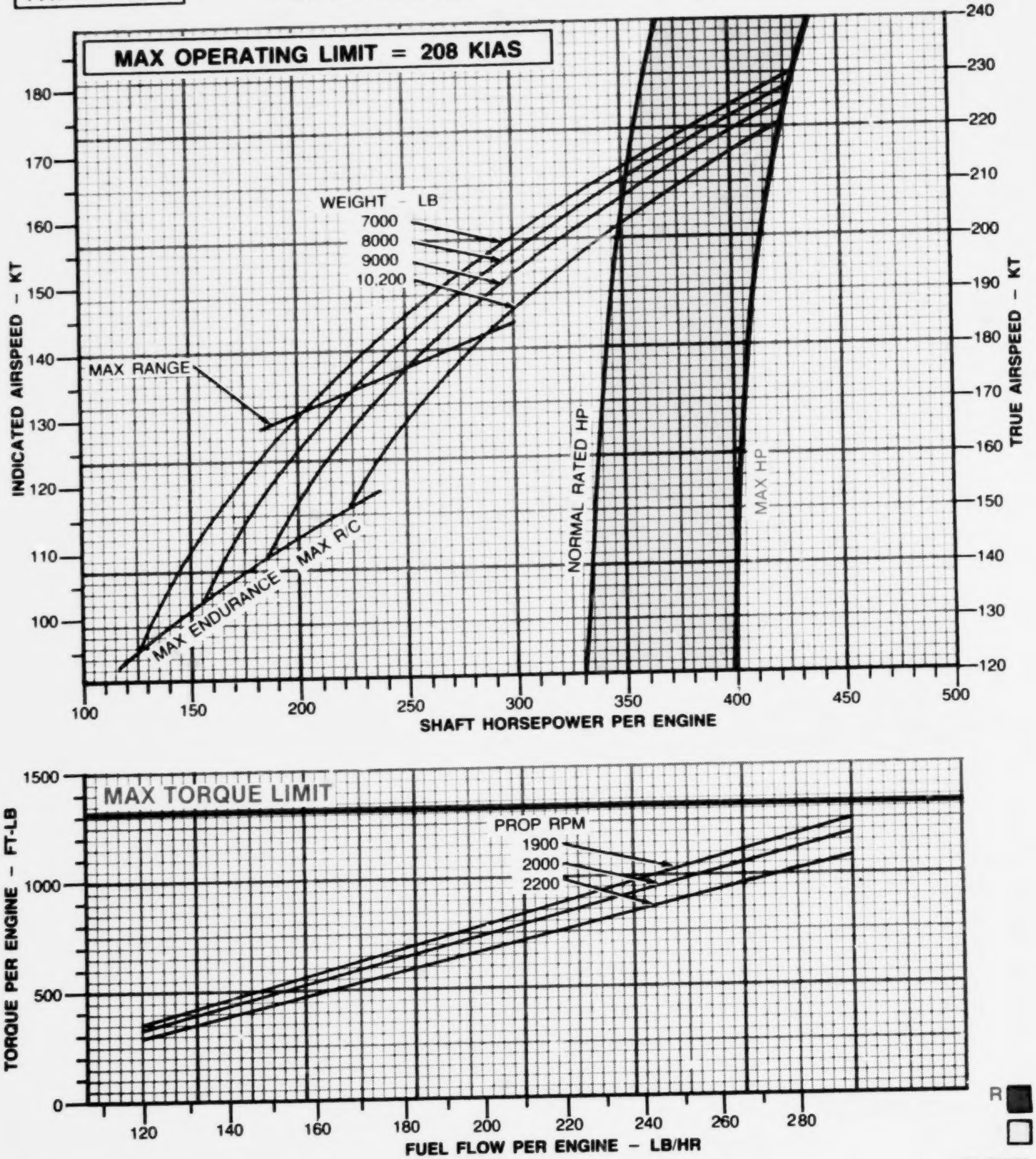
Figure 7-55. Cruise FAT −30°C, 16,000 Ft **RU-21A**

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C



AP 003993

DATA BASIS: ESTIMATED

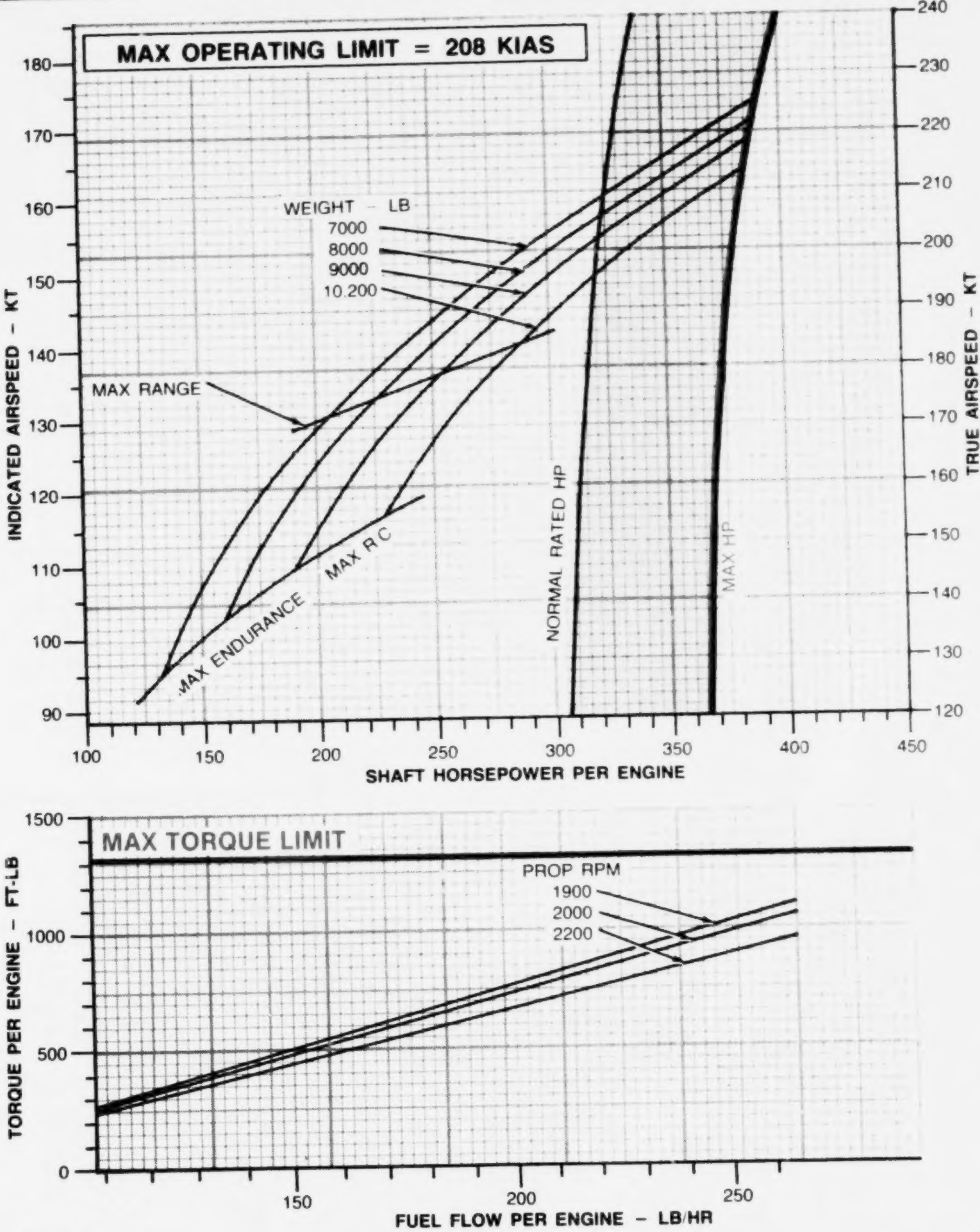
Figure 7-56. Cruise FAT −20°C, 16,000 Ft RU-21A

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



AP 004289

DATA BASIS: ESTIMATED

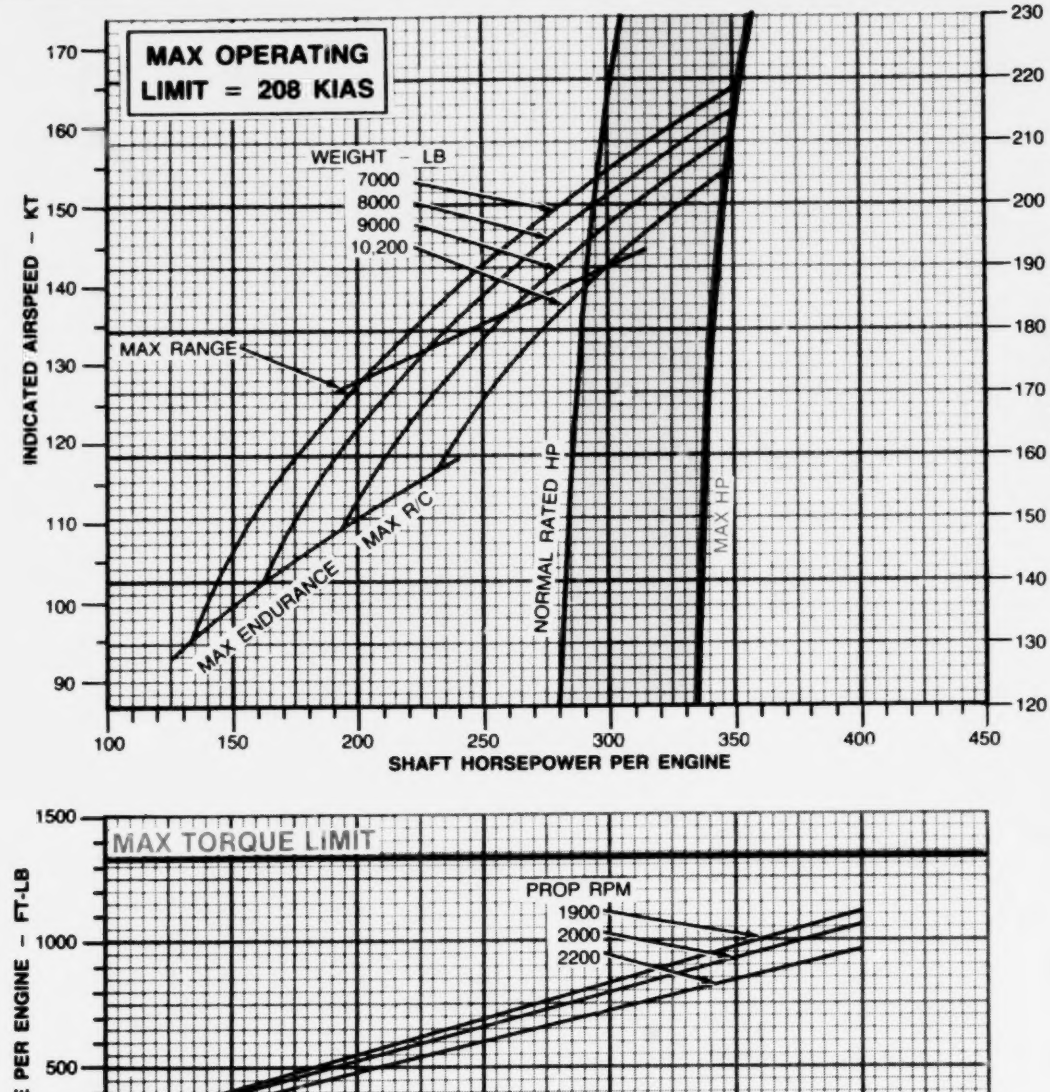
Figure 7-57. Cruise FAT −10°C,16,000 Ft **RU-21A**

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FT
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

AP 003994

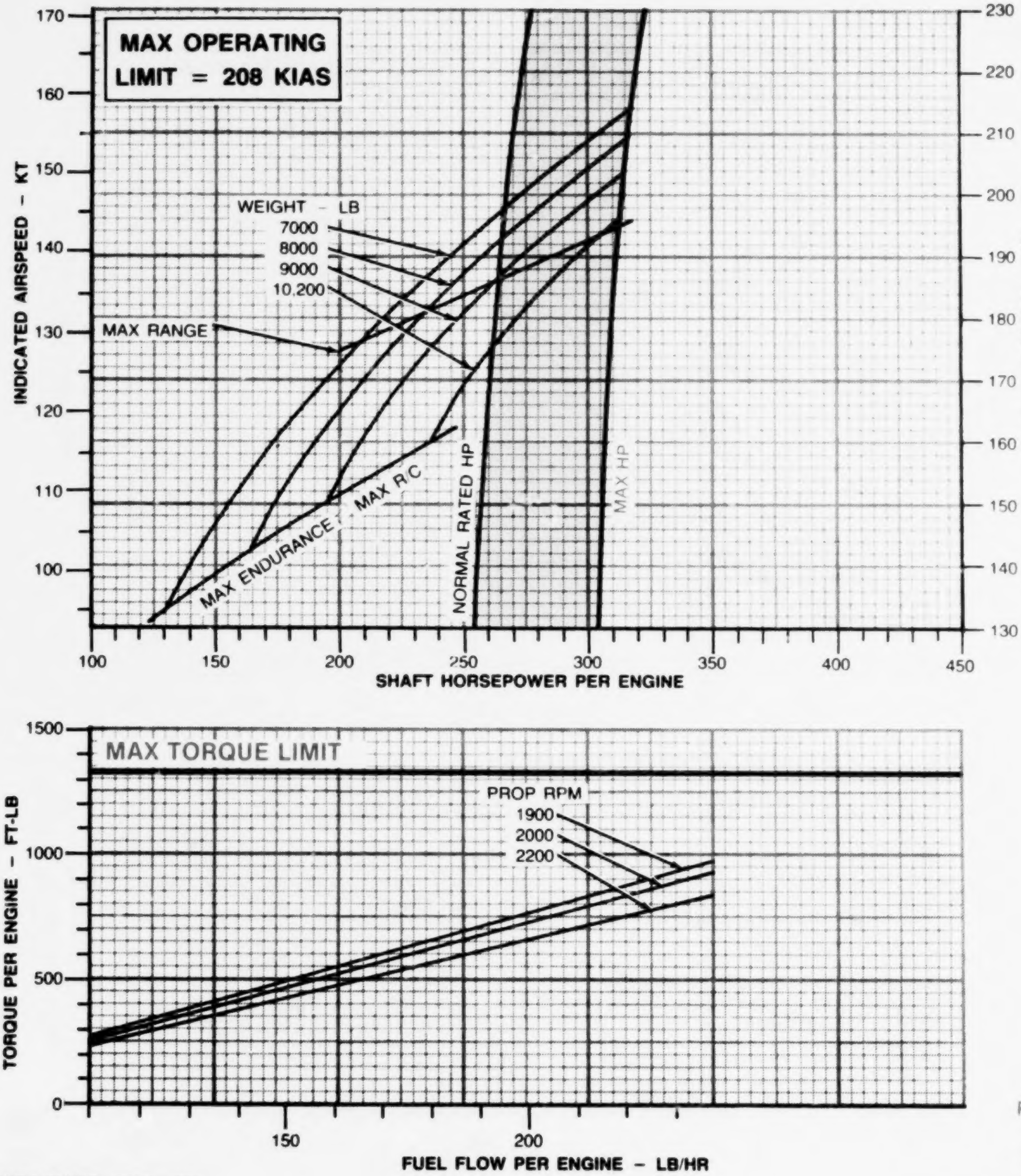
Figure 7-58. Cruise FAT 0°C, 16,000 Ft **RU-21A**

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



DATA BASIS: ESTIMATED

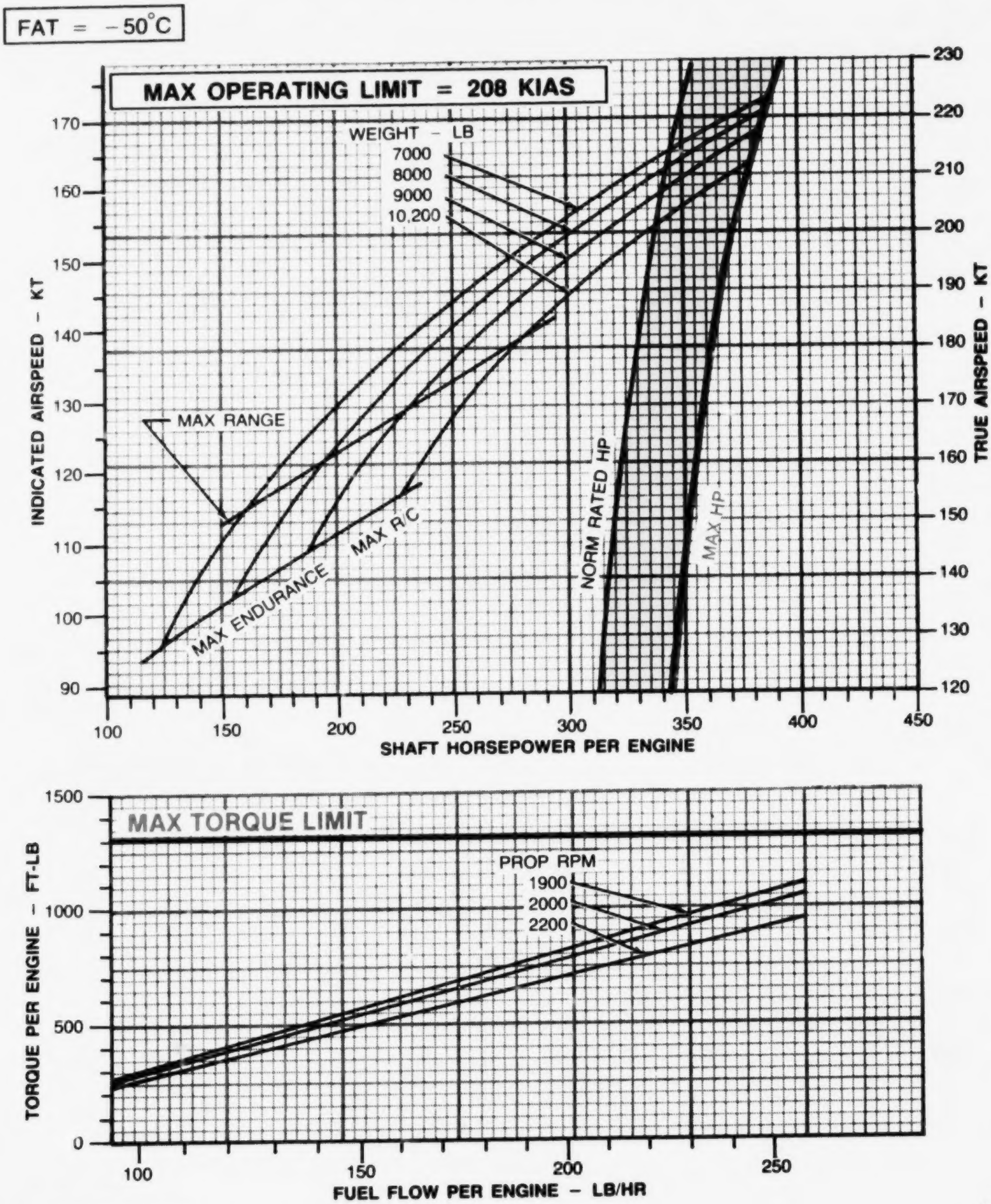
AP 004290

Figure 7-59. Cruise FAT 10°C, 16,000 Ft RU-21A

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP



DATA BASIS: ESTIMATED

AP 003995

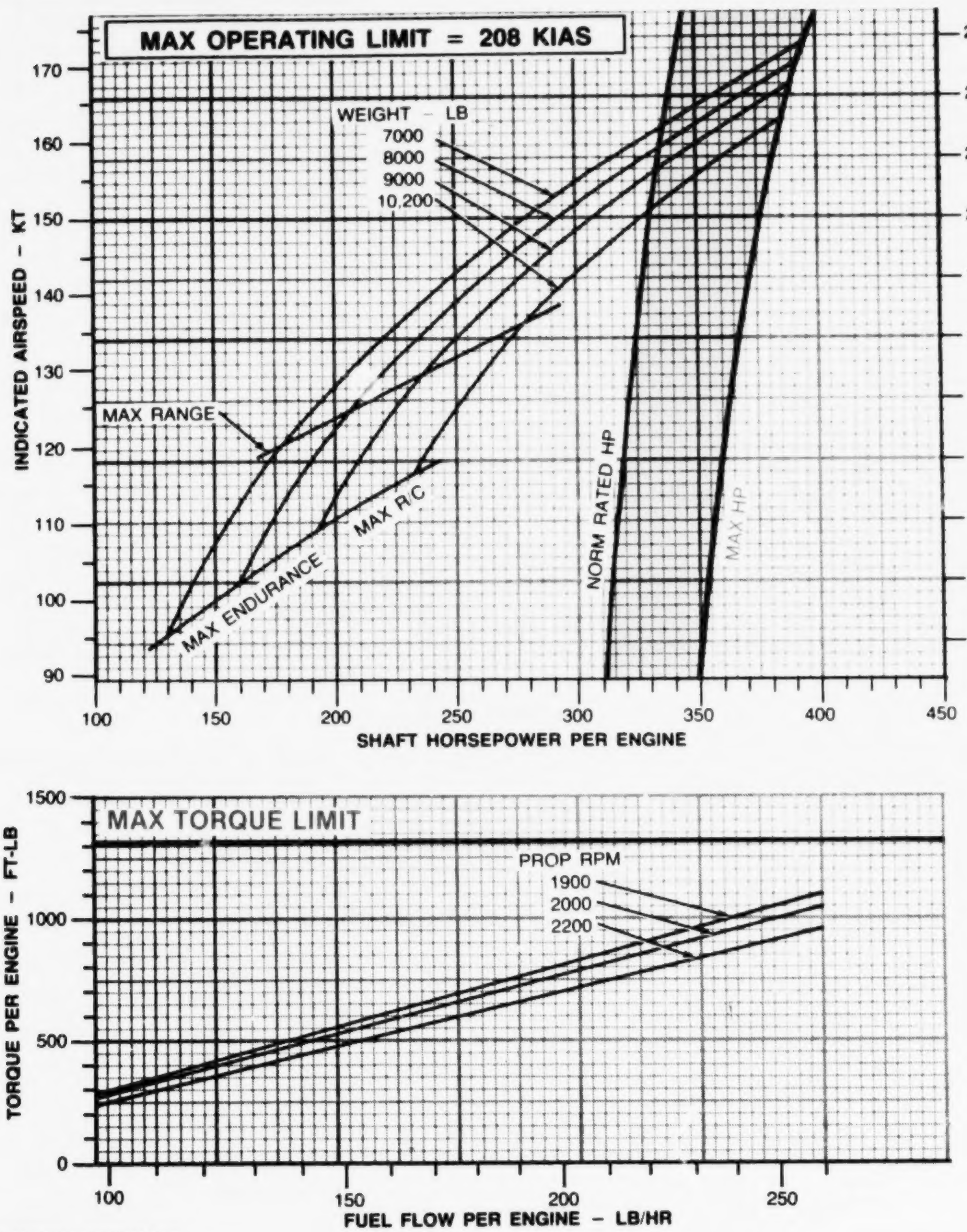
Figure 7-60. Cruise FAT −50°C, 20,000 Ft RU-21A

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21A
T74-CP-700

FAT = −40°C



DATA BASIS: ESTIMATED

AP 004341

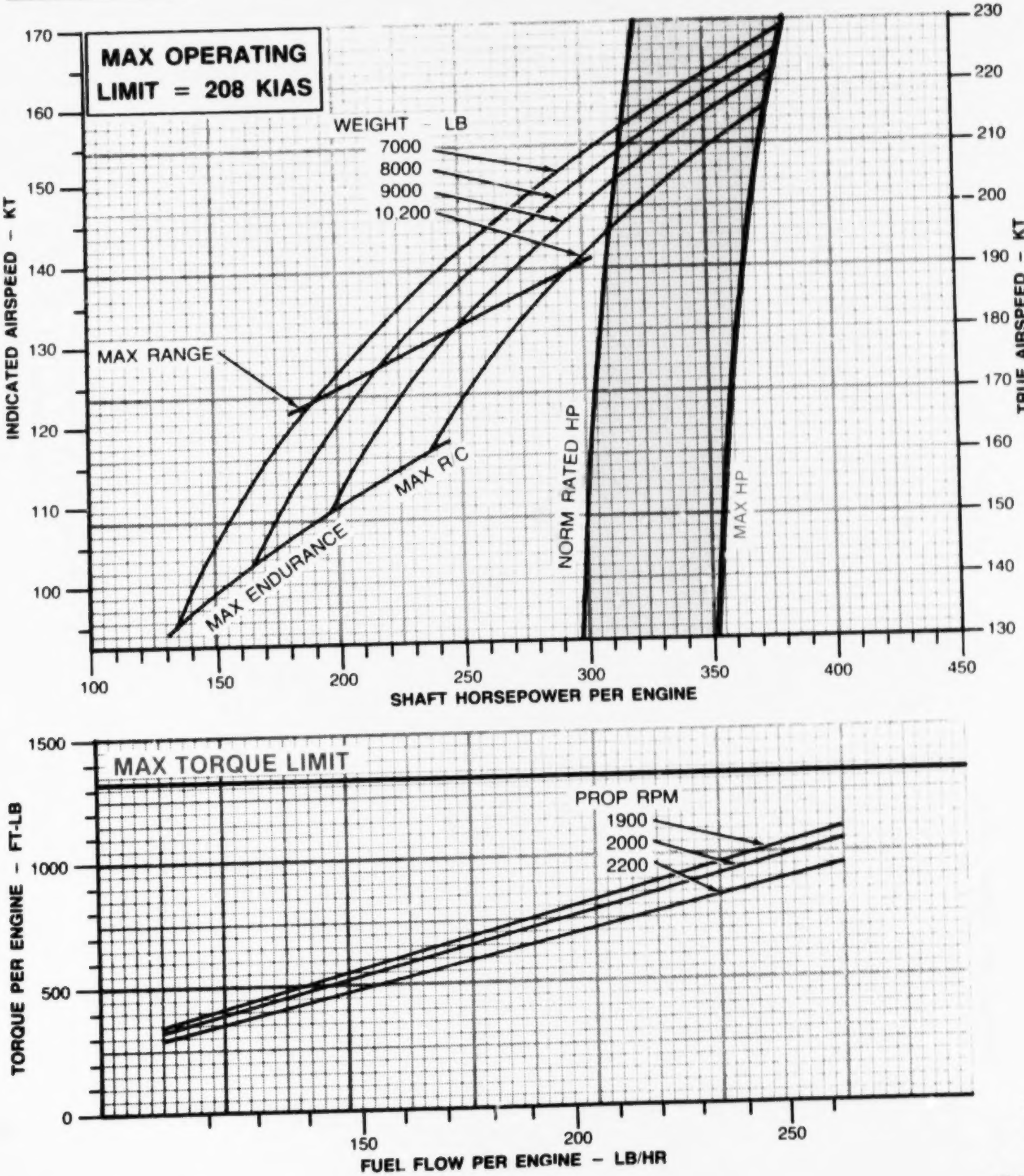
Figure 7-61. Cruise FAT −40°C, 20,000 Ft RU-21A

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



AP 003996

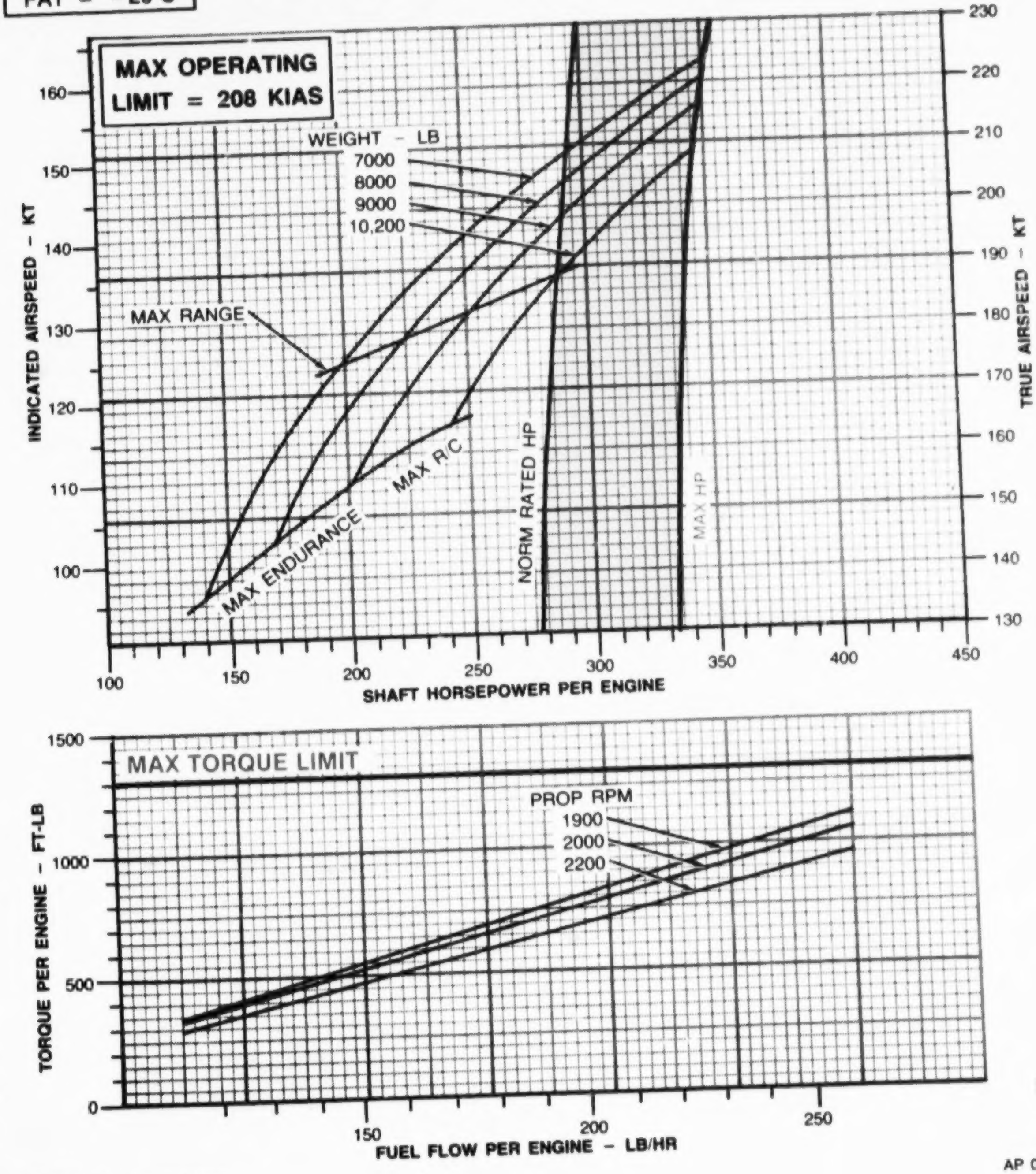
DATA BASIS: ESTIMATED

Figure 7-62. Cruise FAT −30°C, 20,000 Ft **RU-21A**

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C



AP 004342

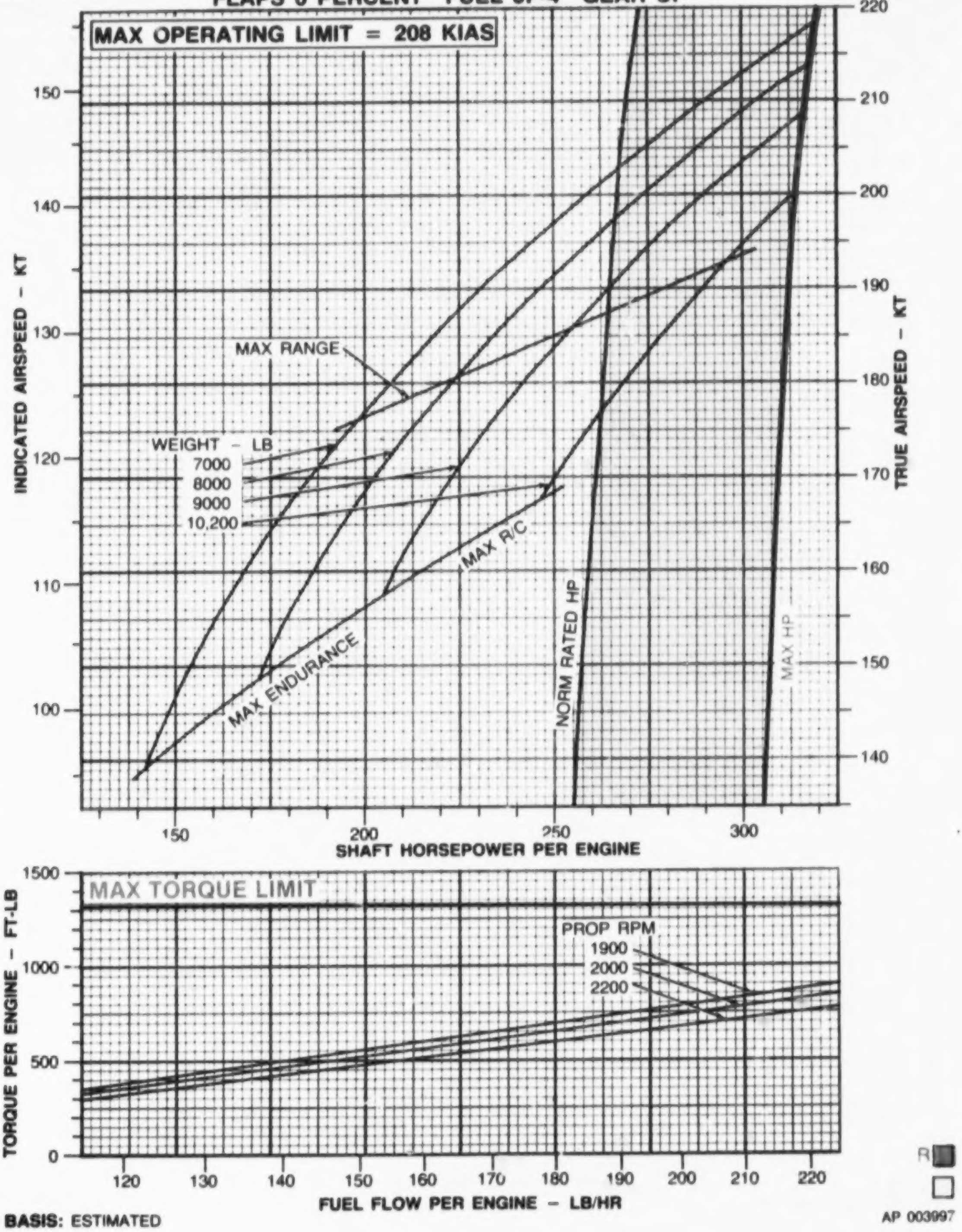
DATA BASIS: ESTIMATED

Figure 7-63. Cruise FAT −20°C, 20,000 Ft **RU-21A**

CRUISE
TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C

CRUISE
RU-21A
T74-CP-700



DATA BASIS: ESTIMATED

AP 003997

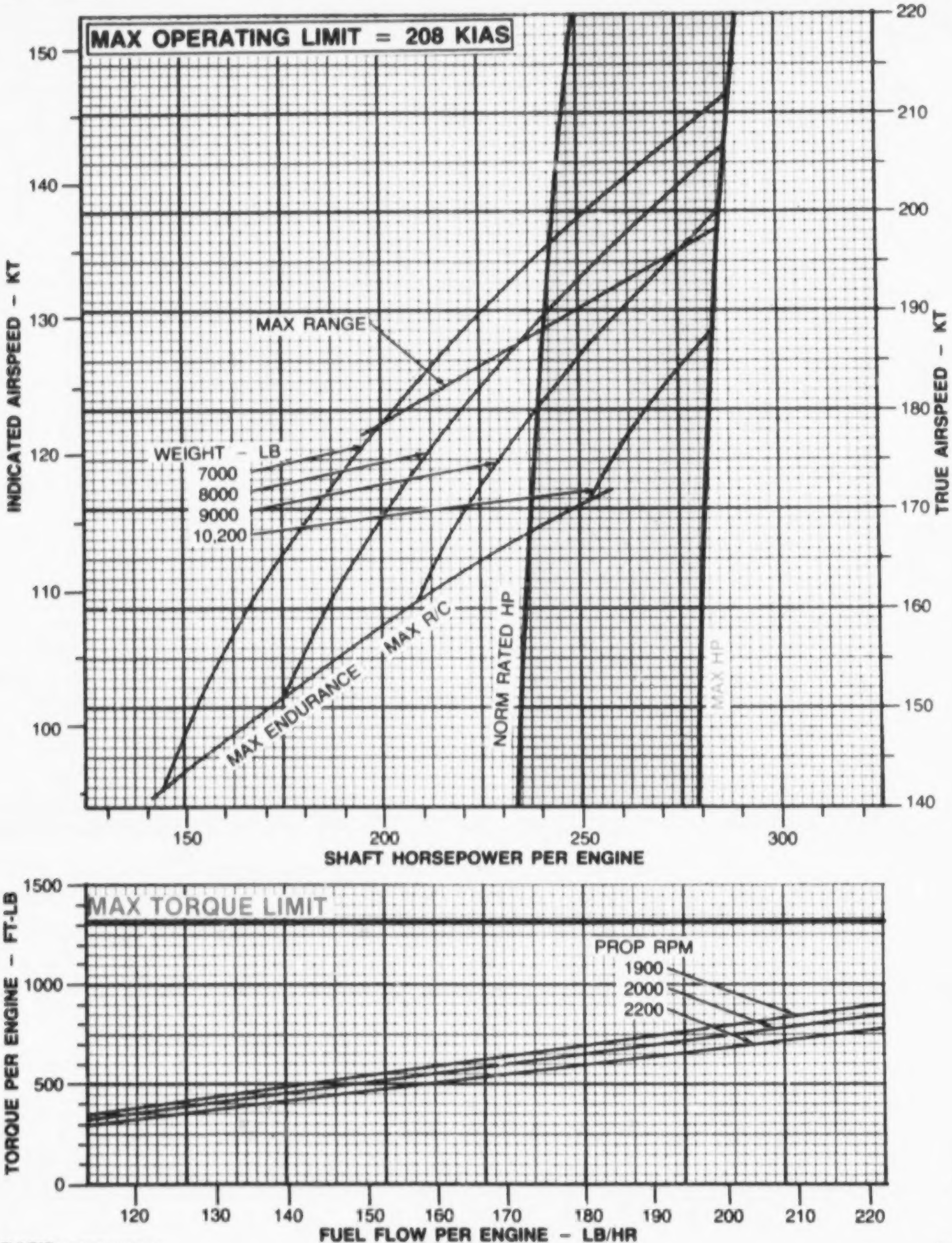
Figure 7-64. Cruise FAT −10°C, 20,000 Ft **RU-21A**

CRUISE
RU-21A
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

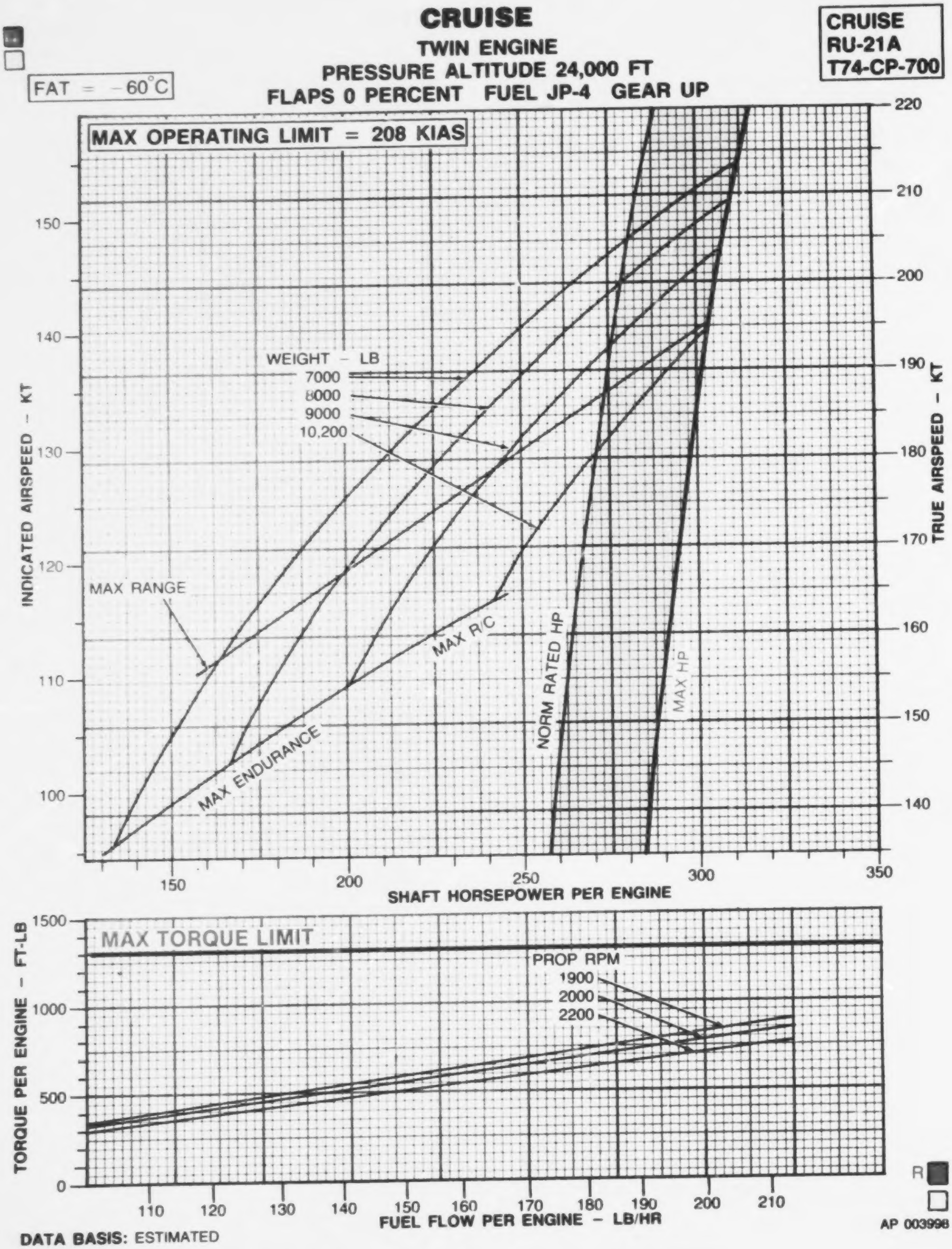
FAT = 0°C



DATA BASIS: ESTIMATED

AP 004343

Figure 7-65. Cruise FAT 0°C, 20,000 Ft **RU-21A**



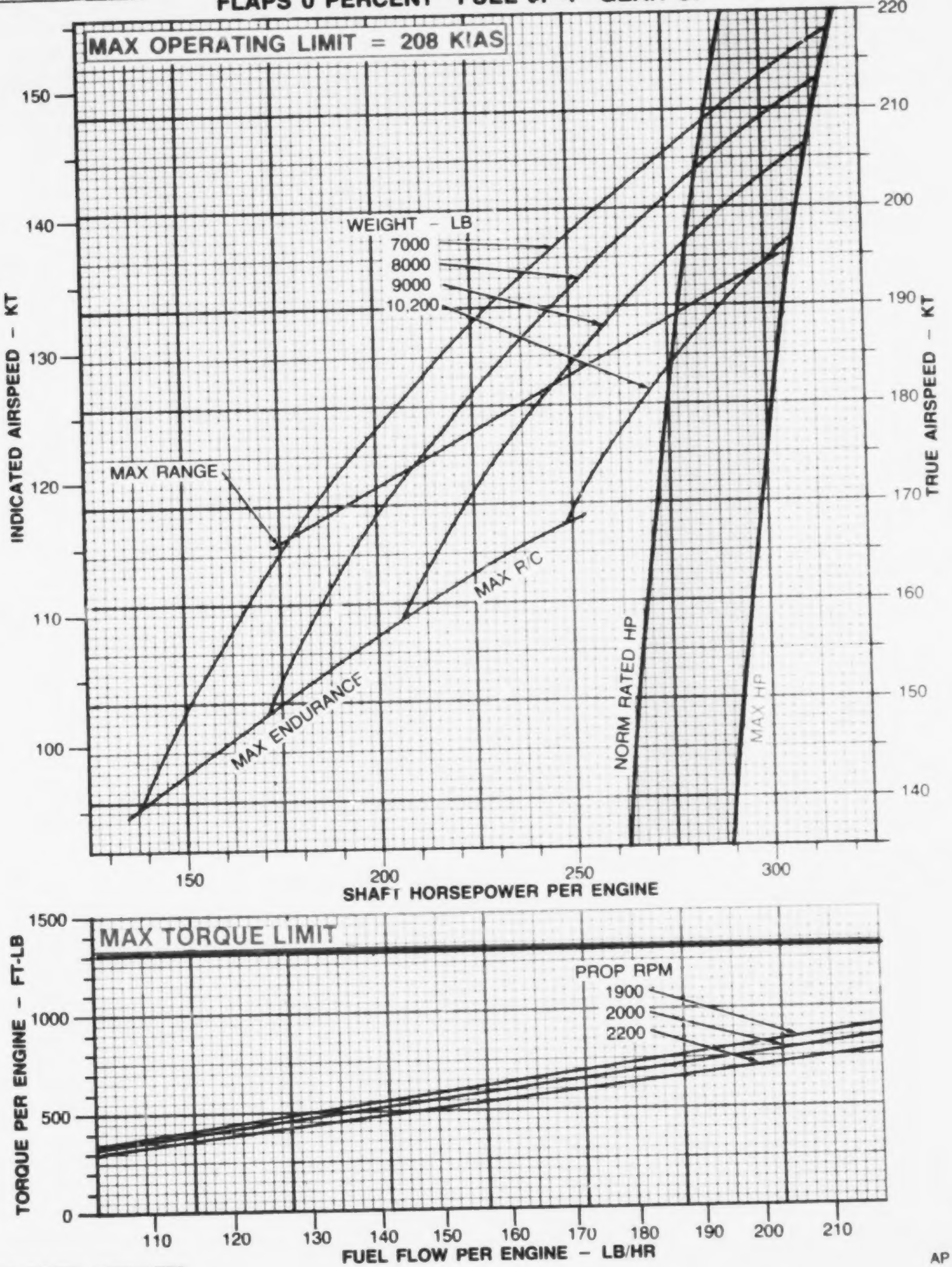
DATA BASIS: ESTIMATED

Figure 7-66. Cruise FAT −60°C, 24,000 Ft RU-21A

CRUISE
TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −50°C

CRUISE
RU-21A
T74-CP-700



DATA BASIS: ESTIMATED

AP 004344

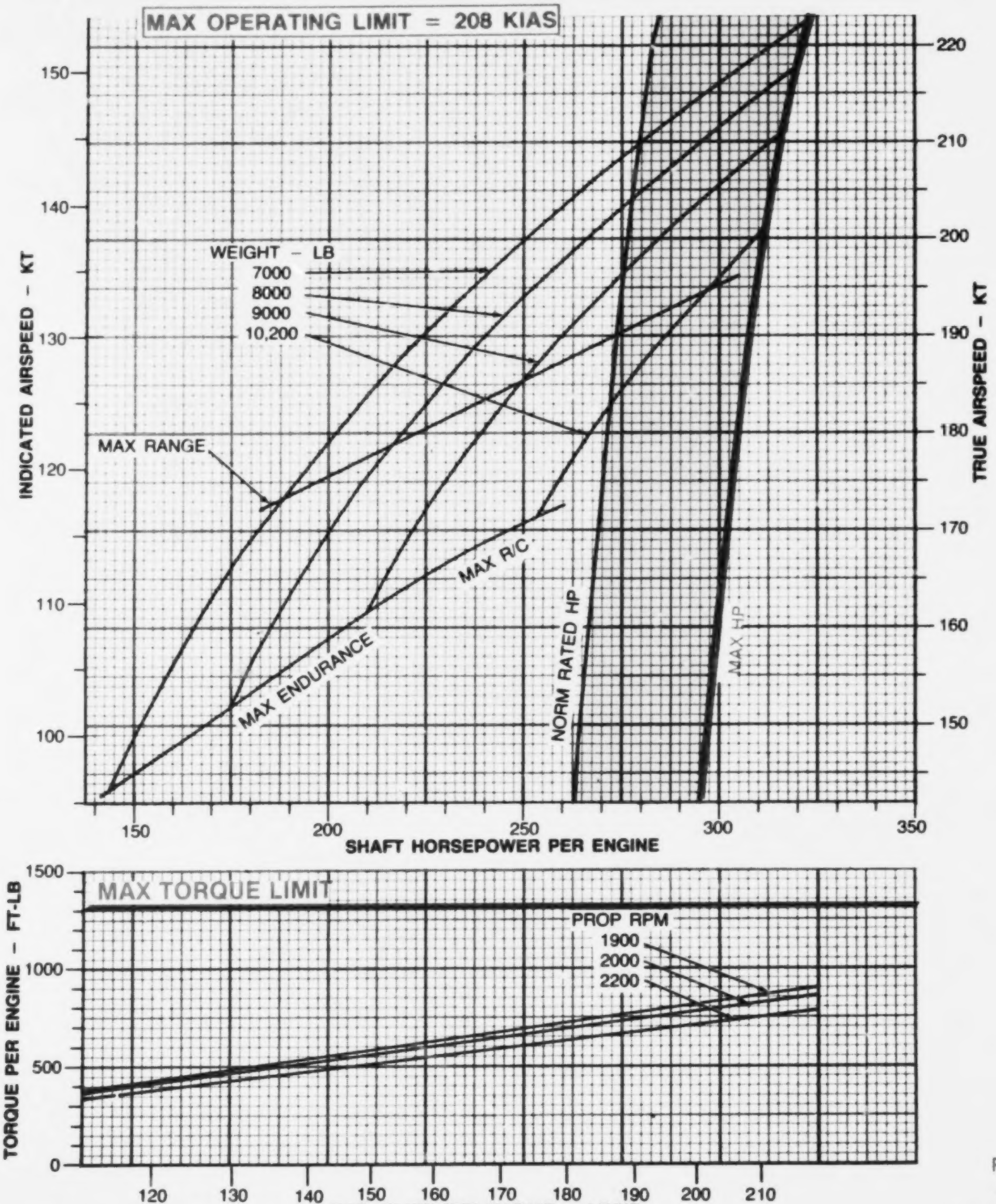
Figure 7-67. Cruise FAT −50°C, 24,000 Ft RU-21A

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −40°C



DATA BASIS: ESTIMATED

AP 003999

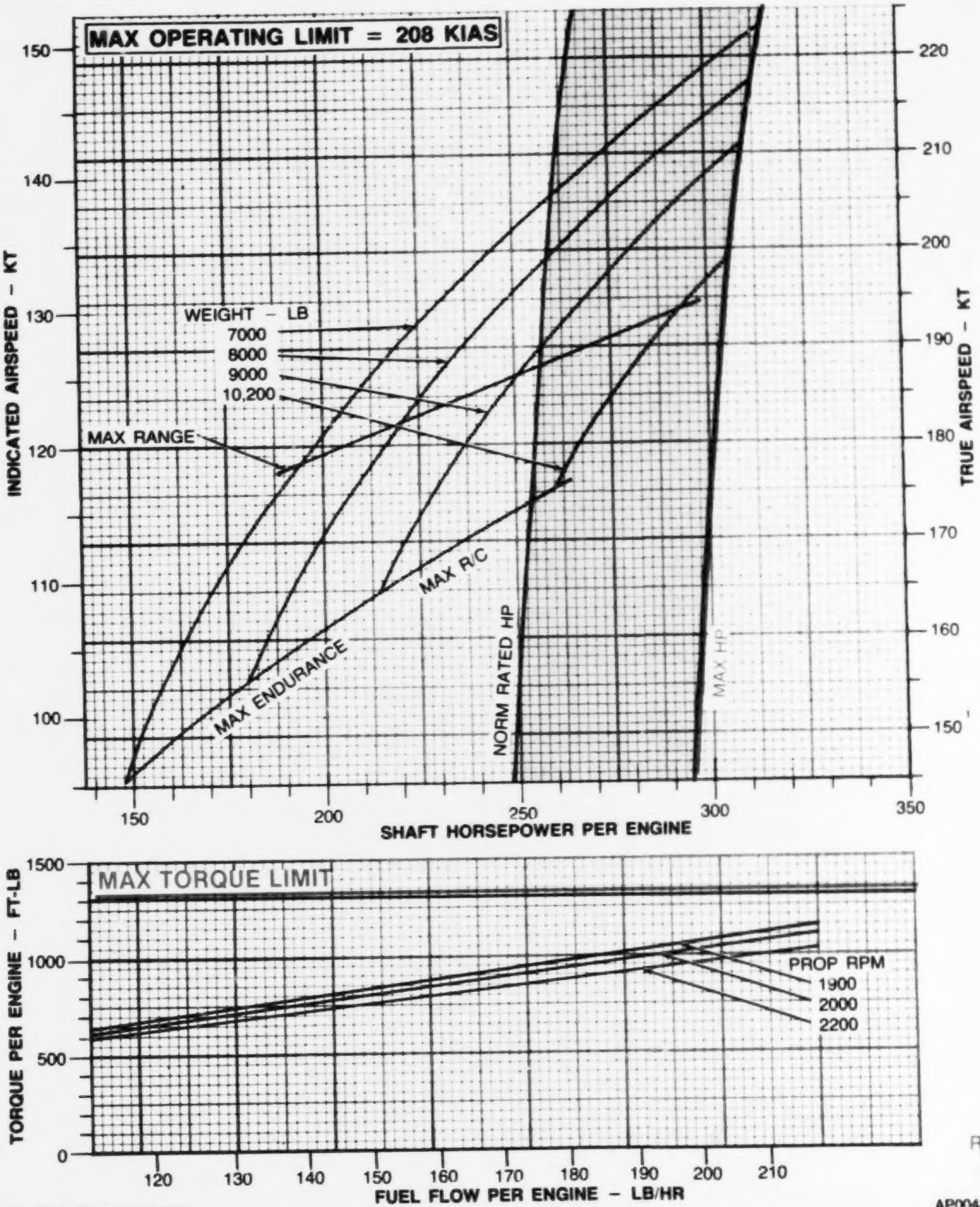
Figure 7-68. Cruise FAT −40°C, 24,000 Ft **RU-21A**

CRUISE
RU-21A
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -30°C



DATA BASIS: ESTIMATED

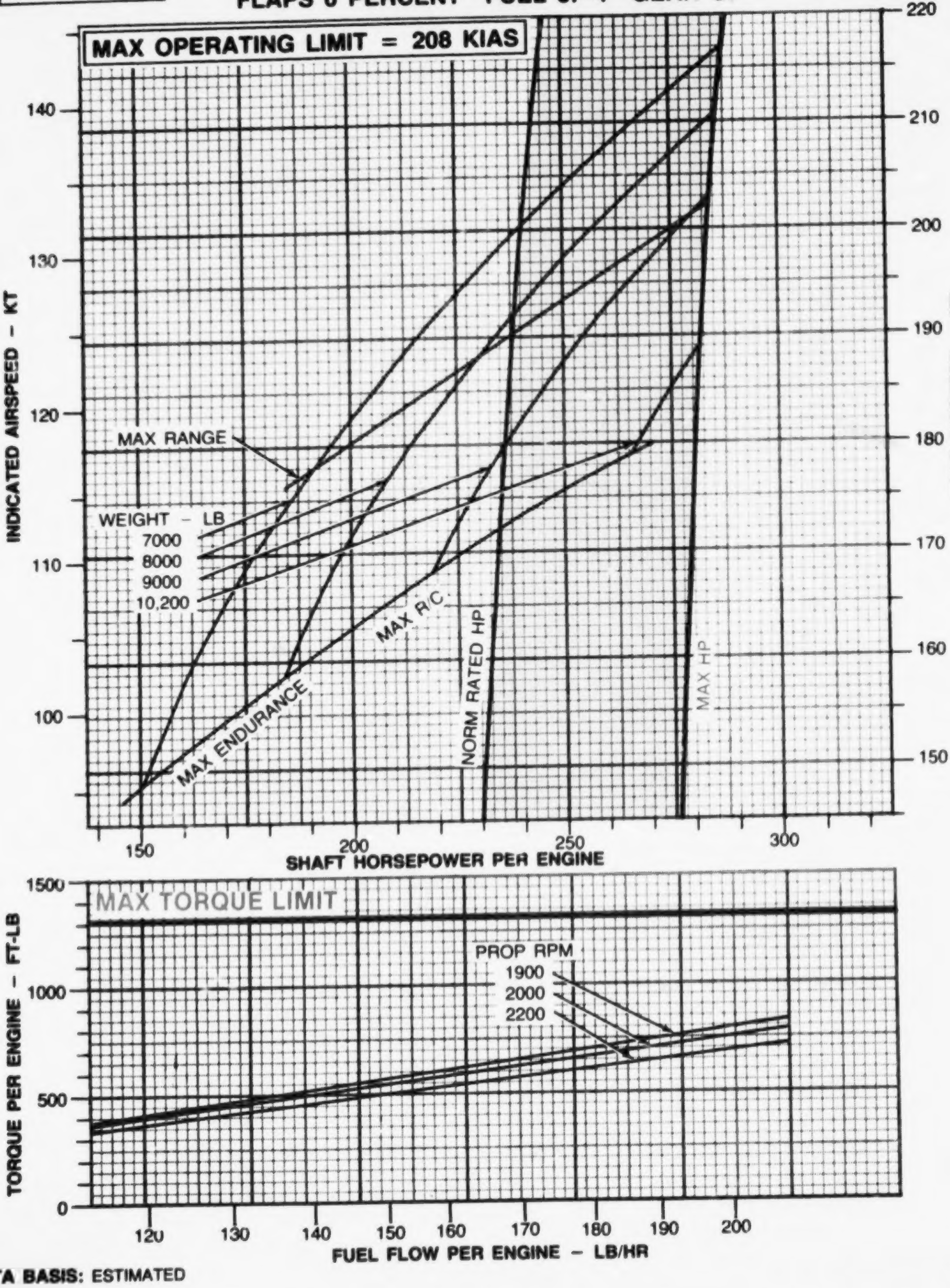
Figure 7 69. Cruise FAT -30°C, 24,000 Ft RU-21A

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C



DATA BASIS: ESTIMATED

AP004000

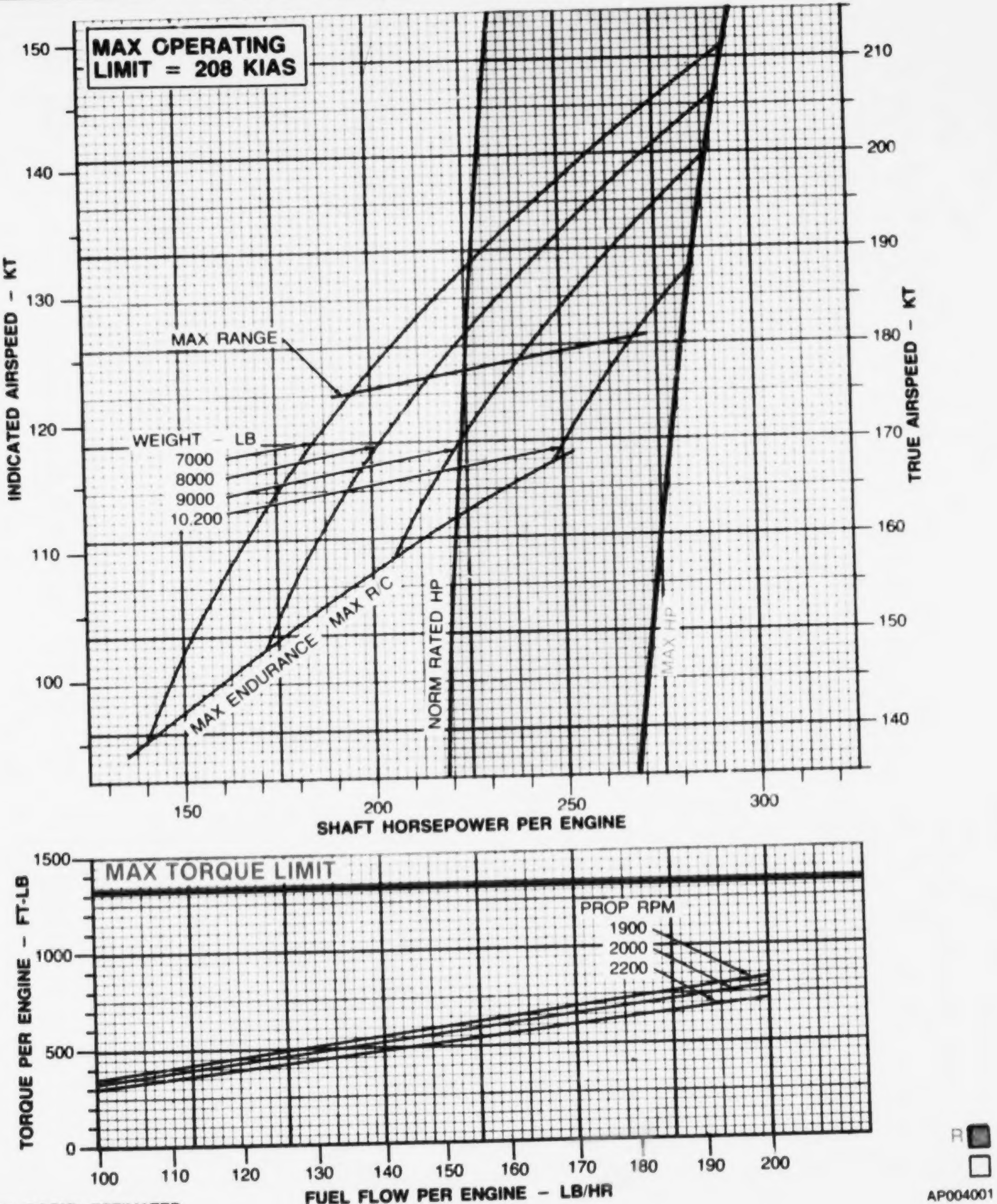
Figure 7-70. Cruise FAT −20°C, 24,000 Ft **RU-21A**

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −60°C



DATA BASIS: ESTIMATED

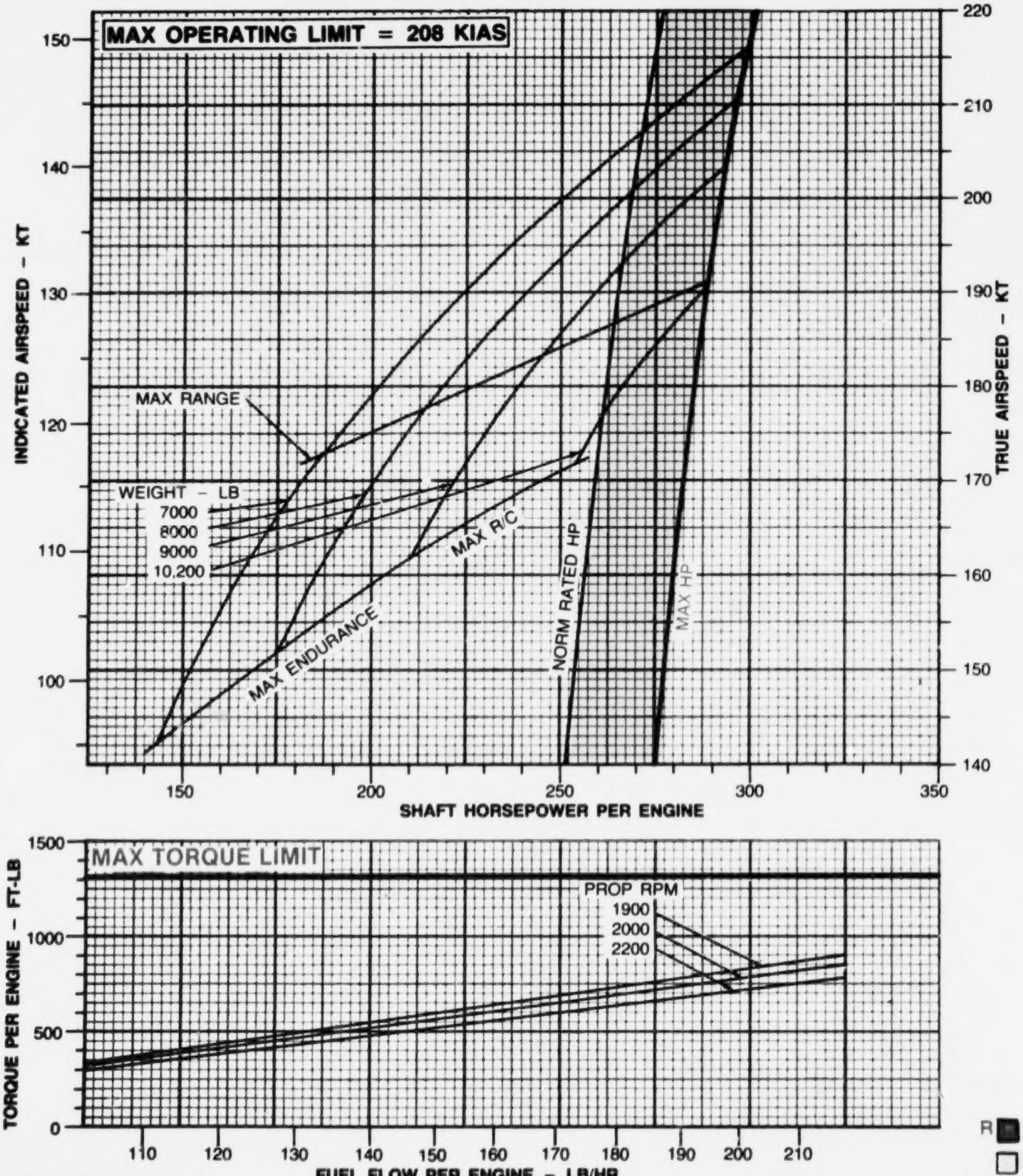
Figure 7-71. Cruise FAT −60°C, 25,000 Ft **RU-21A**

CRUISE

CRUISE
RU-21A
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −50°C



DATA BASIS: ESTIMATED

AP004346

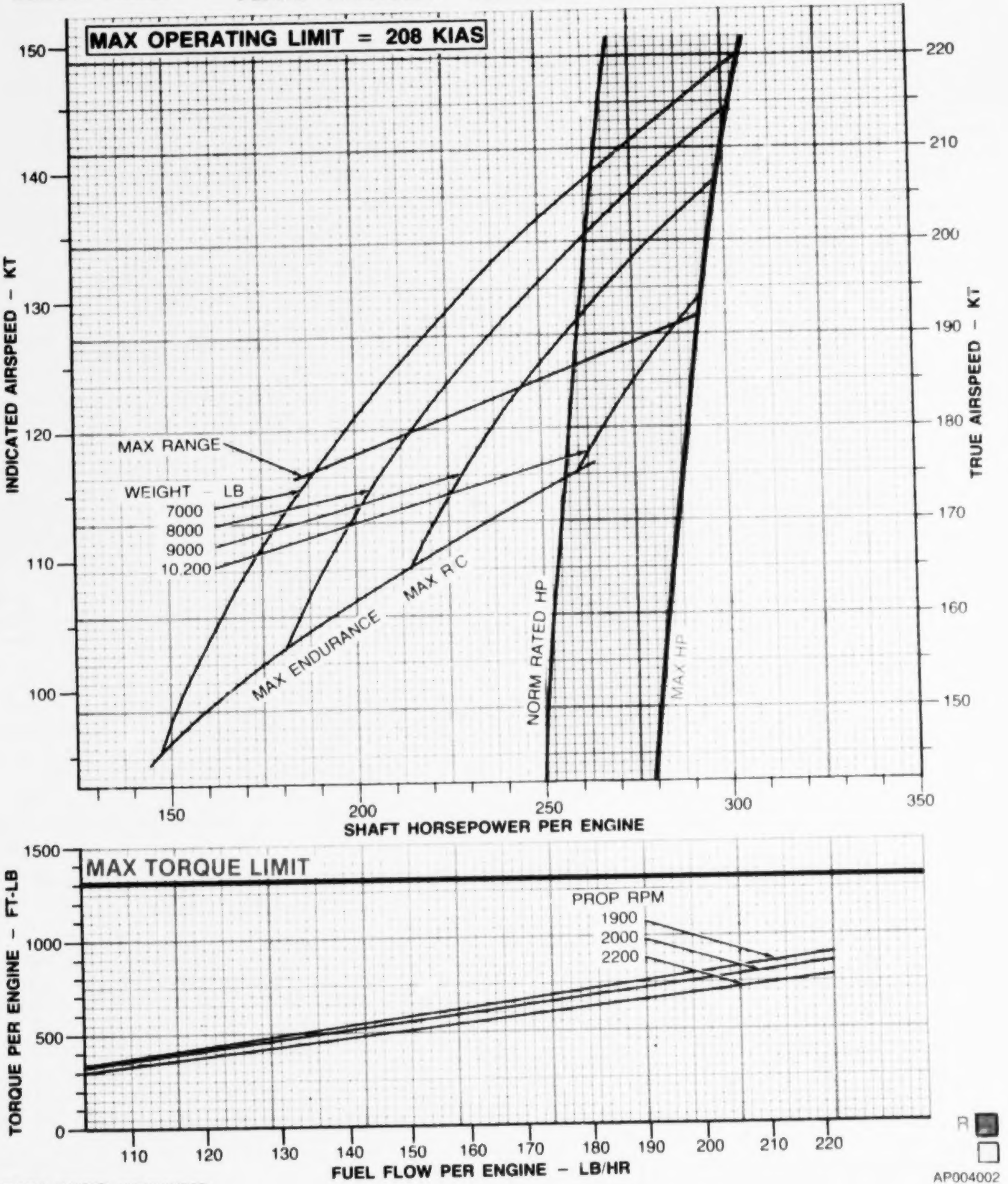
Figure 7-72. Cruise FAT −50°C, 25,000 Ft **RU-21A**

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21A
T74-CP-700

FAT = −40°C



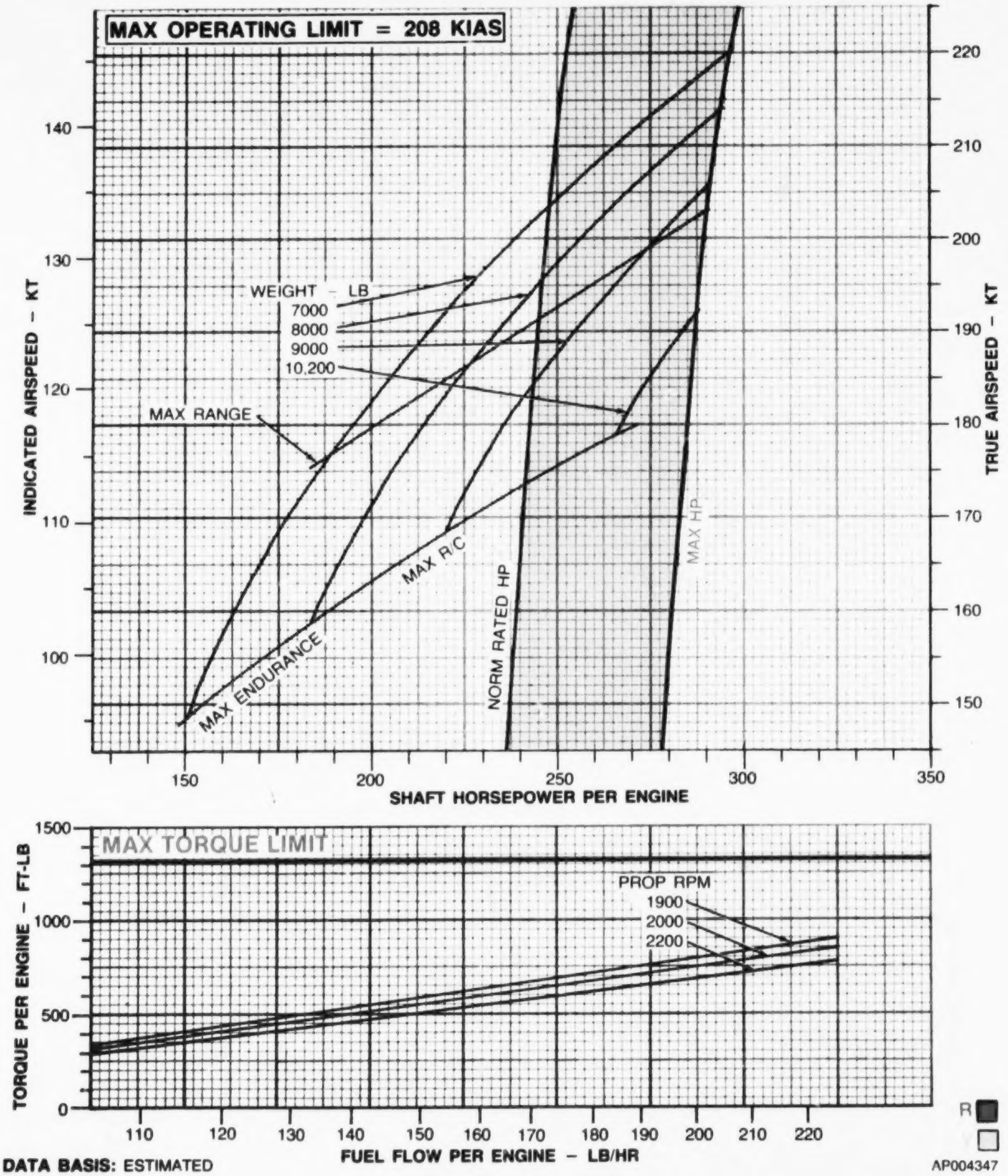
DATA BASIS: ESTIMATED

Figure 7-73. Cruise FAT −40°C, 25,000 Ft RU-21A

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



DATA BASIS: ESTIMATED

Figure 7-74. Cruise FAT −30°C, 25,000 Ft RU-21A

7-80. Description. **RU-21D**

The Cruise Charts (fig. 7-75 thru fig. 7-123), show the horsepower per engine for various airspeeds and weights at selected combinations of altitude and temperature. Cruise and climb fuel flows are shown corresponding to engine power. Maximum performance lines are shown. Torque variation with propeller speed and engine horsepower are shown. Two engine and single-engine data are presented on the chart. Each individual chart is for a single pressure altitude and FAT.

7-81. Use of Chart. **RU-21D**

The primary use of the Cruise Chart is shown in Cruise examples (fig. 7-75). Other uses for the chart are described under "Other uses for Chart" (para. 7-81). The Cruise charts are for use in determining power settings to obtain a desired level of performance for a known set of conditions of altitude, temperature, weight and number of operating engines. Normally, sufficient accuracy can be obtained by selecting the chart nearest to the planned cruising altitude and temperature. If greater accuracy is desired, interpolation between two or more charts should be used. The power setting is obtained by adjusting torque and propeller speed.

a. Maximum Range. The maximum range line shows the airspeed which will provide the maximum range for a given aircraft weight at the chart conditions.

b. Maximum Endurance. The maximum endurance line shows the airspeed which will provide maximum endurance for a given aircraft weight at the chart conditions.

c. Maximum Rate Of Climb. The maximum rate of climb line shows the airspeed which would provide maximum rate of climb for a given aircraft weight if maximum horsepower was used at the chart conditions.

d. Airspeed. The relationship between indicated and true airspeed is shown for the specific chart conditions of altitude and temperature. Conversion between the two airspeeds can be accomplished without regard to other chart information.

e. Fuel Flow. The fuel flow for cruise and climb settings is shown.

NOTE

Fuel flow values should be doubled for two engine operation.

f. Horsepower Per Engine. Horsepower per engine, although not readable in the cockpit is utilized in conjunction with the Climb/Descent Chart (fig. 7-125), to obtain rate of climb or descent.

7-82. Conditions. **RU-21D**

a. Configuration. All cruise data are based on the aircraft in a clean configuration.

b. Fuel. Fuel flow is based on use of JP-4 aviation fuel.

c. Operation. Areas not recommended for cruise operation are shown in yellow.

7-83. Other Uses of Chart. **RU-21D**

a. Selected True Airspeed.

Wanted
Indicated airspeed, horsepower per engine
Fuel flow, and torque for a selected cruise true airspeed

Known
Pressure altitude
FAT
Weight
Prop RPM

Method
Enter chart for true airspeed
Move right
Read indicated airspeed
Move down from weight line
Read horsepower per engine
Move down
Read fuel flow
Move left from prop RPM
Read torque

b. Climb Conditions.

Wanted
Maximum rate of climb airspeed
Horsepower required for level flight at MAX R/C airspeed
Max horsepower available
Fuel flow and torque for MAX R/C
Excess horsepower available for climb

■
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CRUISE

PRESSURE ALTITUDE 12,000 FT EXAMPLE
FLAPS UP GEAR UP

CRUISE
RU-21D
T74-CP-700

EXAMPLE

WANTED

TRUE AIRSPEED, INDICATED AIRSPEED, HORSEPOWER PER ENGINE, FUEL FLOW PER ENGINE, AND TORQUE FOR MAX RANGE CRUISE

KNOWN

WEIGHT = 9000 LB
PRESSURE ALTITUDE = 12,000 FT
FAT = −5°C
PROP SPEED = 1900 RPM

METHOD 1 (SIMPLEST)

USE CHART FOR NEXT HIGHER CONDITION (0°C)
ENTER MAX RANGE HERE
MOVE RIGHT AND UP TO WEIGHT
MOVE RIGHT, READ TRUE AIRSPEED = 175 KTAS
MOVE LEFT, READ INDICATED AIRSPEED = 142 KIAS
MOVE DOWN, READ HORSEPOWER PER ENGINE = 276 SHP
MOVE DOWN, READ FUEL FLOW PER ENGINE = 206 LB/HR
MOVE LEFT FROM PROP RPM, READ TORQUE PER ENGINE = 760 FT-LB

METHOD 2 (INTERPOLATE)

READ TRUE AIRSPEED, INDICATED AIRSPEED, HORSEPOWER, FUEL FLOW, AND TORQUE AT EACH ADJACENT ALTITUDE AND FAT, THEN INTERPOLATE

ALTITUDE	12,000 FT	12,000 FT	12,000 FT
FAT	−10°C	−5°C	0°C
TRUE AIRSPEED	173	174	175
INDICATED AIRSPEED	143	143	142
HORSEPOWER	274	275	276
FUEL FLOW	204	205	206
TORQUE	757	759	760

EXAMPLE

WANTED

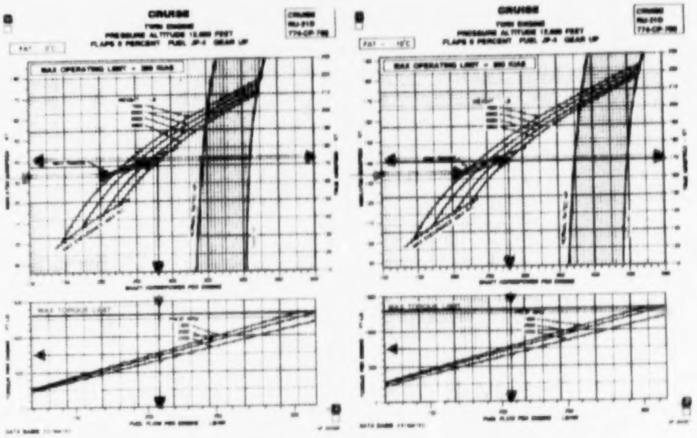
INDICATED AIRSPEED, HORSEPOWER PER ENGINE, FUEL FLOW, AND TORQUE FOR A DESIRED TRUE AIRSPEED

KNOWN

DESIRED TRUE AIRSPEED = 200 KTS
WEIGHT = 9000 LB
PRESSURE ALTITUDE = 12,000 FT
FAT = 0°C
PROP SPEED = 1900 RPM

METHOD

ENTER DESIRED TRUE AIRSPEED ON RIGHT = 200 KTAS
MOVE LEFT TO WEIGHT AND INDICATED AIRSPEED = 163 KIAS
MOVE DOWN FROM WEIGHT, READ HORSEPOWER = 365 SHP
MOVE DOWN, READ FUEL FLOW = 252 LB/HR
MOVE LEFT FROM PROP RPM, READ TORQUE = 1007 FT-LB



EXAMPLE

WANTED

MAX RATE OF CLIMB, INDICATED AIRSPEED, HORSEPOWER PER ENGINE FOR LEVEL FLIGHT AT MAX R/C AIRSPEED, MAX CONT. HORSEPOWER AVAILABLE, EXCESS HORSEPOWER AVAILABLE FOR CLIMB, FUEL FLOW AND TORQUE FOR MAX CLIMB

KNOWN

WEIGHT = 9650 LB
PRESSURE ALTITUDE = 12,000 FT
FAT = 0°C
PROP SPEED = 2200 RPM

METHOD

ENTER CHART AT MAX R/C LINE
MOVE RIGHT AND UP TO WEIGHT = 9650 LB
MOVE LEFT, READ MAX R/C INDICATED AIRSPEED = 119 KIAS
MOVE DOWN FROM WEIGHT LINE, READ HORSEPOWER REQUIRED FOR LEVEL FLIGHT AT MAX R/C AIRSPEED = 228 SHP
MOVE DOWN FROM MAX CONT. HP LINE, READ MAX CONT. HORSEPOWER AVAILABLE = 407 SHP
MOVE DOWN FROM MAX CONT. HP AVAILABLE, READ CLIMB FUEL FLOW = 271 LB/HR
MOVE LEFT FROM PROP RPM, READ TORQUE TO SET FOR CLIMB = 959 FT-LB
DETERMINE EXCESS HORSEPOWER PER ENGINE AVAILABLE FOR CLIMB − MAX CONT. HORSEPOWER AVAILABLE, LESS HORSEPOWER REQUIRED FOR LEVEL FLIGHT = 407 SHP − 228 SHP = 179 SHP PER ENGINE

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R ■

AP 000846

DATA BASIS: ESTIMATED

Figure 7-75. Cruise Example RU-21D

Known

Pressure altitude
OAT
Weight
Prop RPM

Method

Enter chart at MAX R/C line
Move right and up to weight
Move left and read MAX R/C true airspeed
Move right and read MAX R/C indicated airspeed
Move down from weight line
Read horsepower per engine for level flight at MAX R/C airspeed
Read MAX horsepower available per engine at MAX R/C airspeed
Move down from MAX horsepower available
Read climb fuel flow
Move left from prop RPM line
Read torque
Determine excess horsepower per engine available for climb - MAX horsepower available per engine less horsepower per engine for level flight

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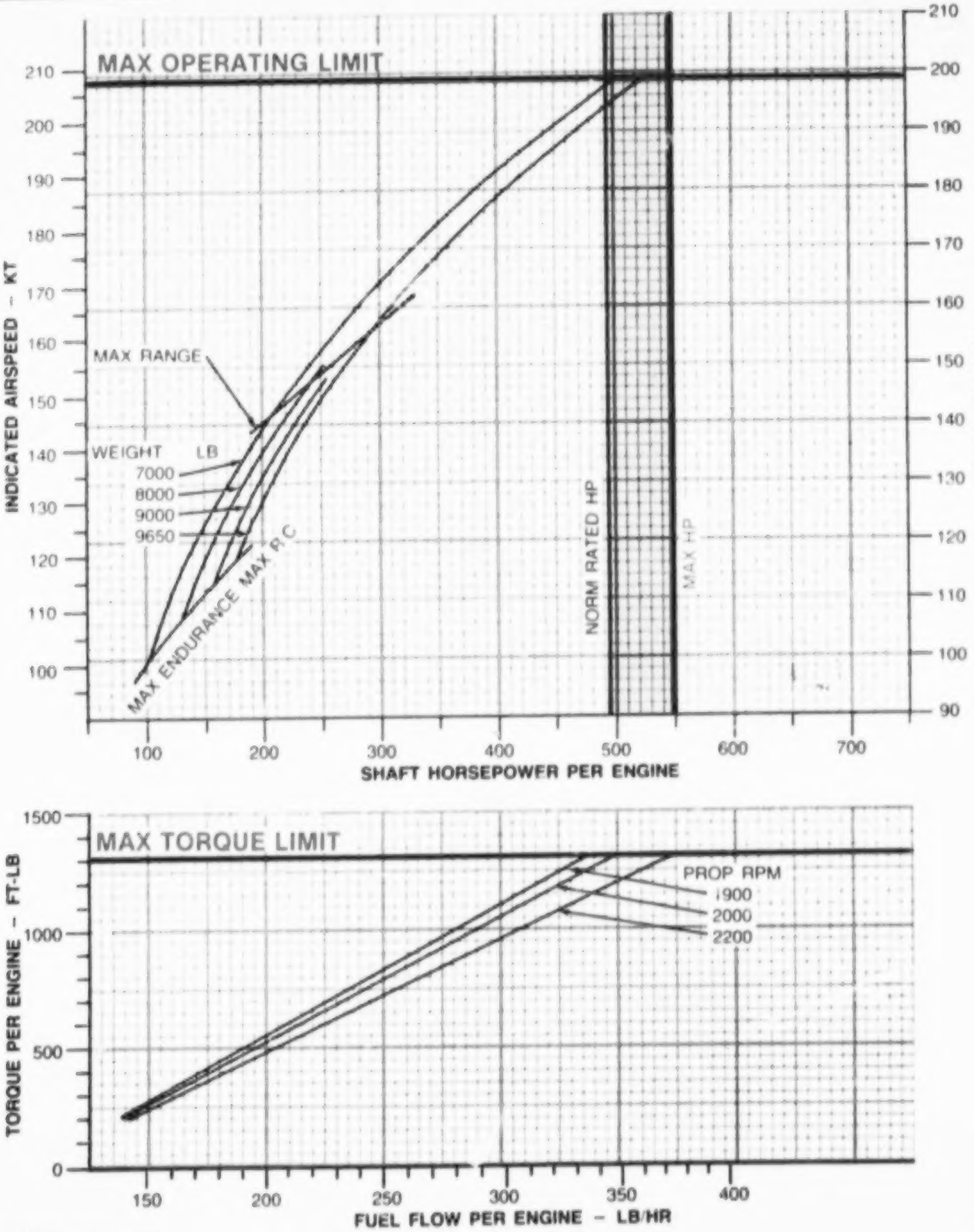
☐

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = −10°C



DATA BASIS: ESTIMATED

R ☐

AP 004274 1

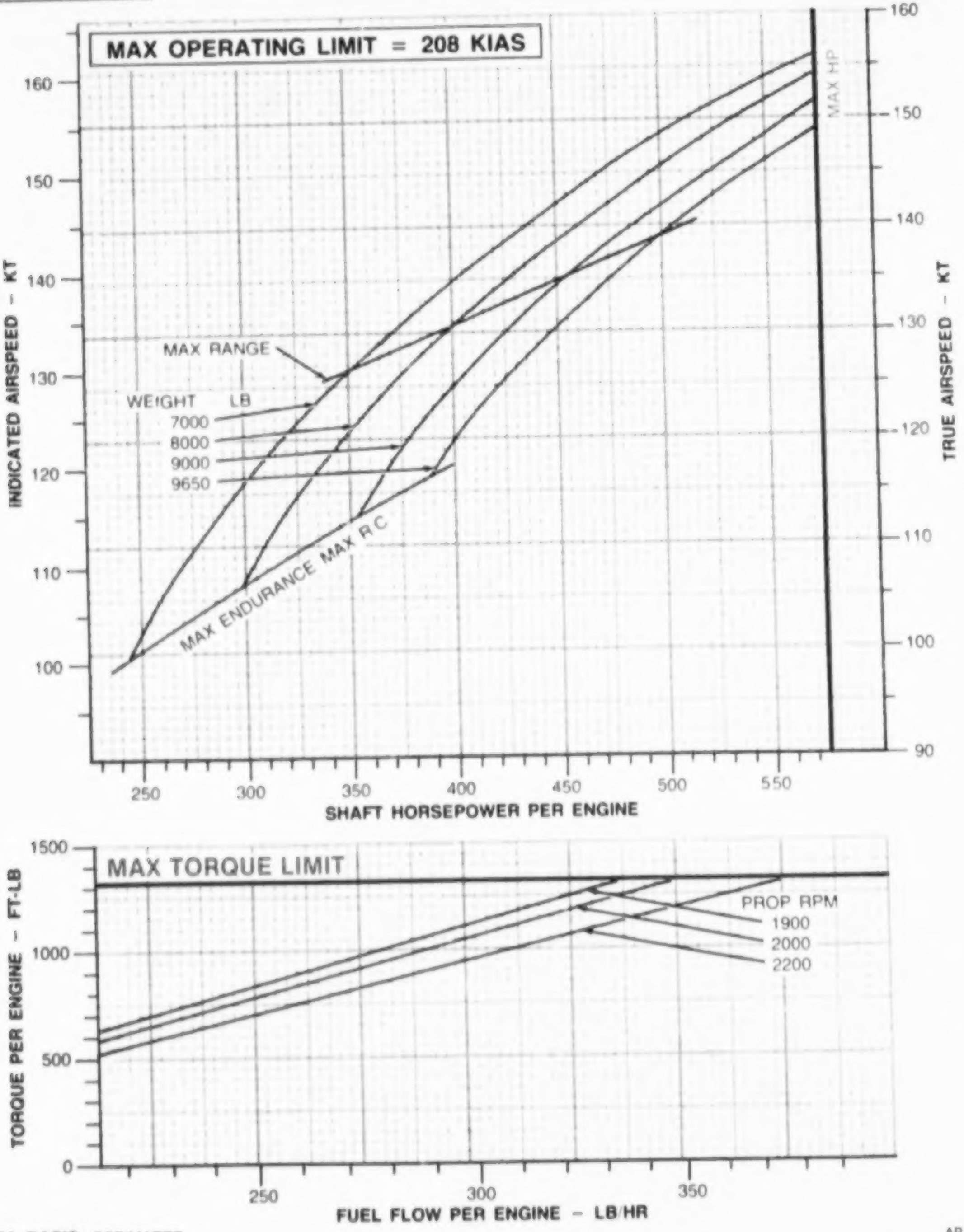
Figure 7-76. Cruise FAT −10°C, Sea Level **RU-21D** *(Sheet 1 of 2)*

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = −10°C



DATA BASIS: ESTIMATED

AP 004274 2

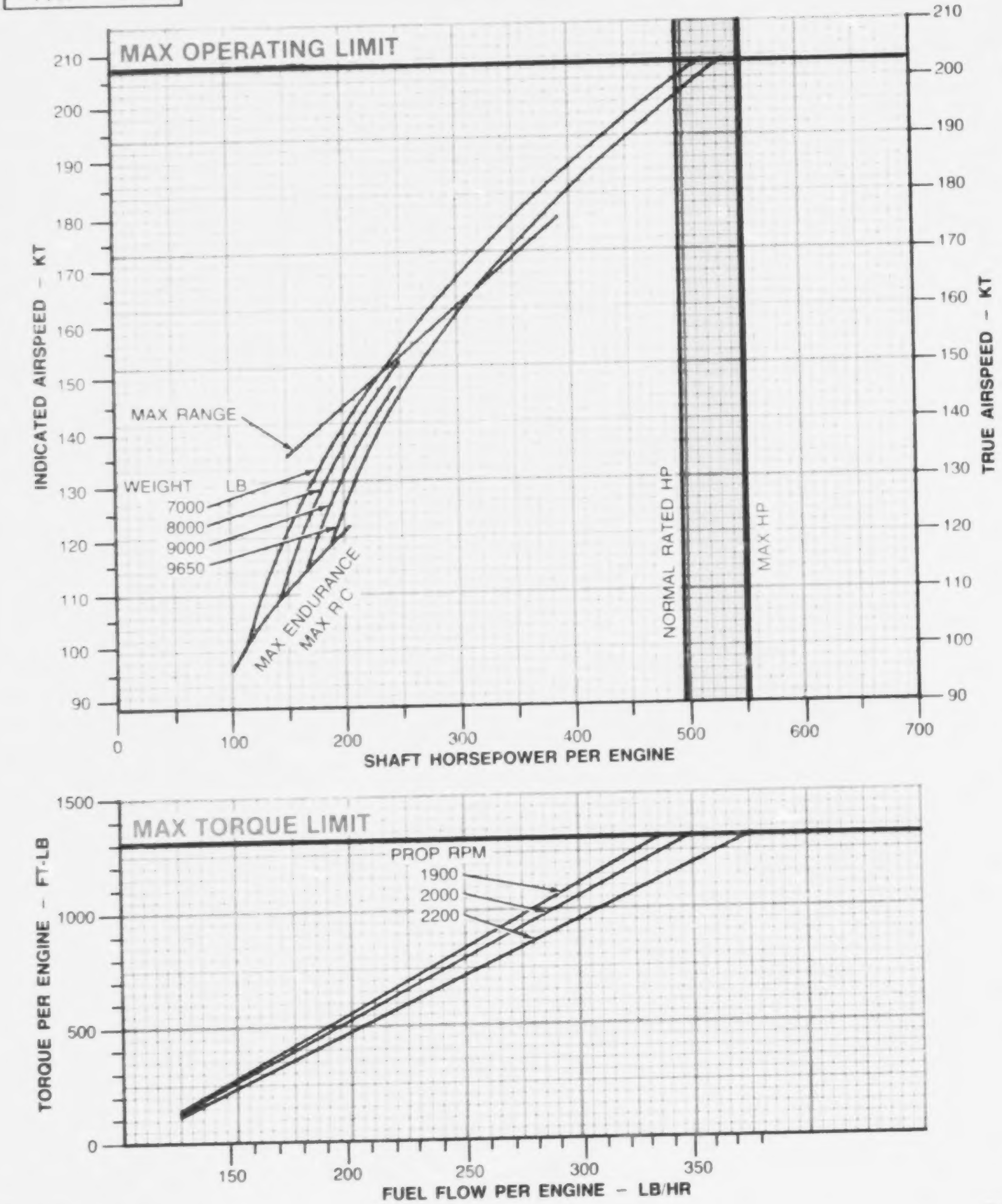
Figure 7-76. Cruise FAT −10°C, Sea Level **RU-21D** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 0°C



AP 004275 1

DATA BASIS: ESTIMATED

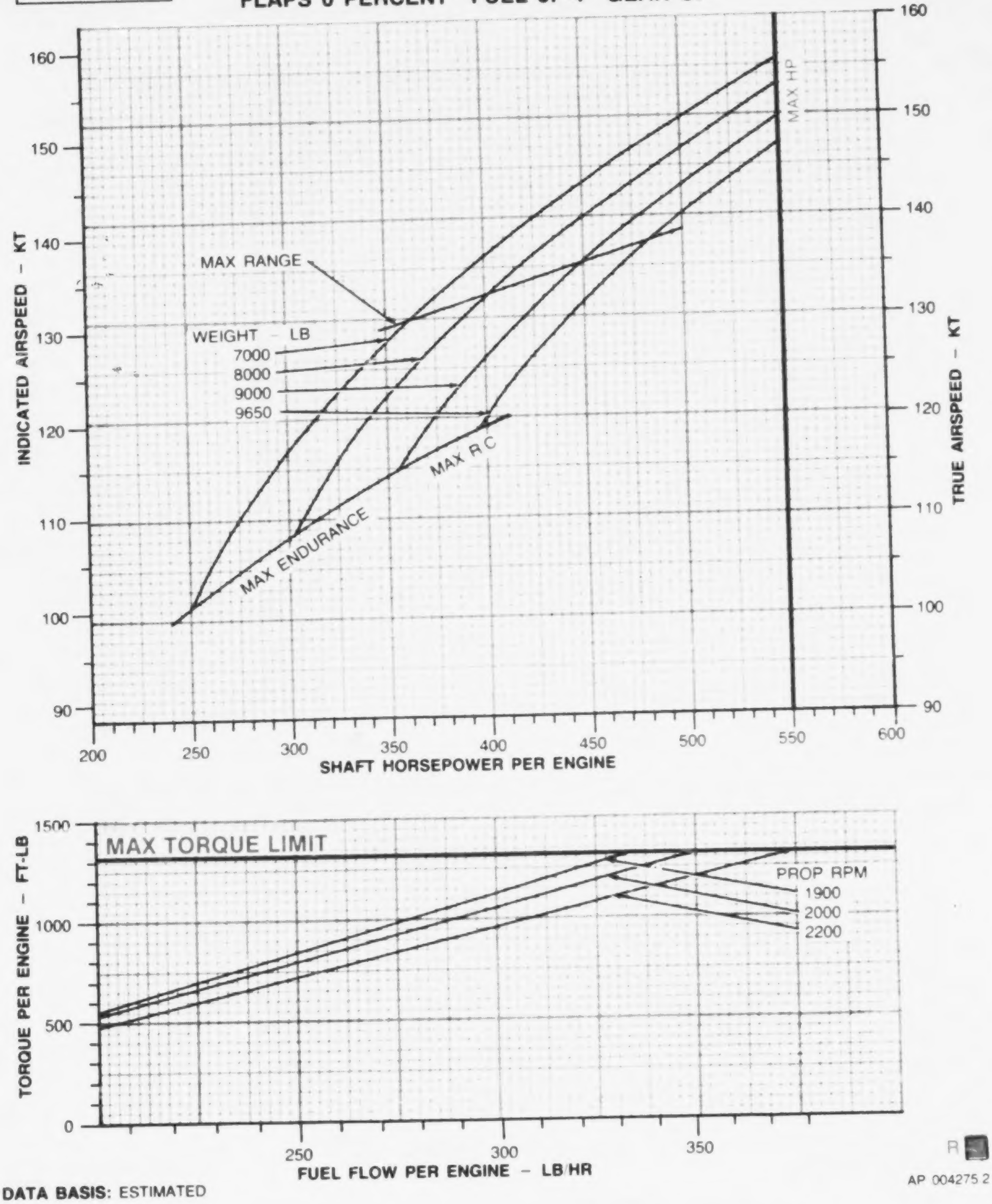
Figure 7-77. Cruise FAT 0°C, Sea Level RU-21D *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21D
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C



DATA BASIS: ESTIMATED

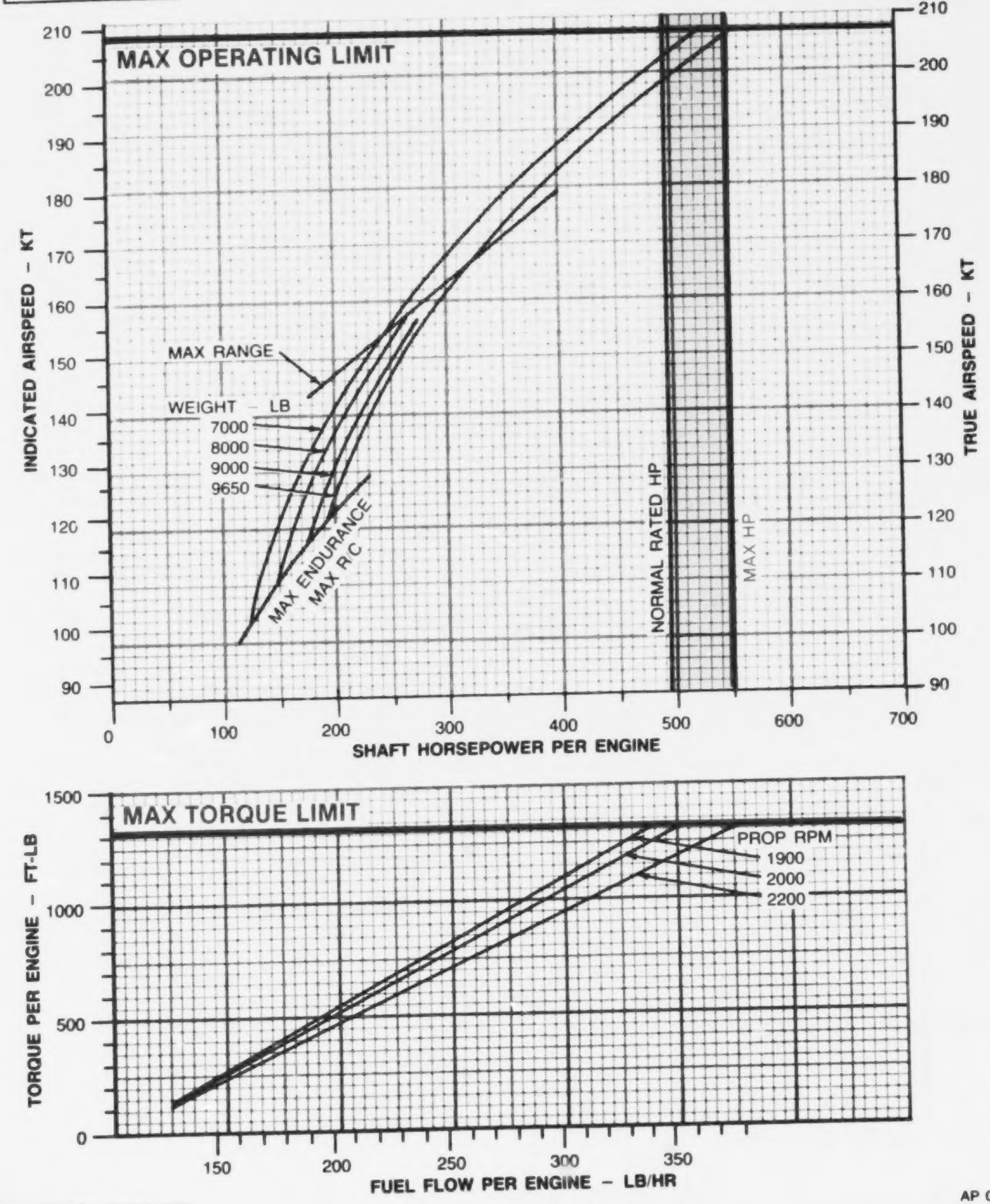
Figure 7-77. Cruise FAT 0°C, Sea Level **RU-21D** *(Sheet 2 of 2)*

CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FLAP JP-4 GEAR UP

FAT = 10°C



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AP 004276.1

DATA BASIS: ESTIMATED

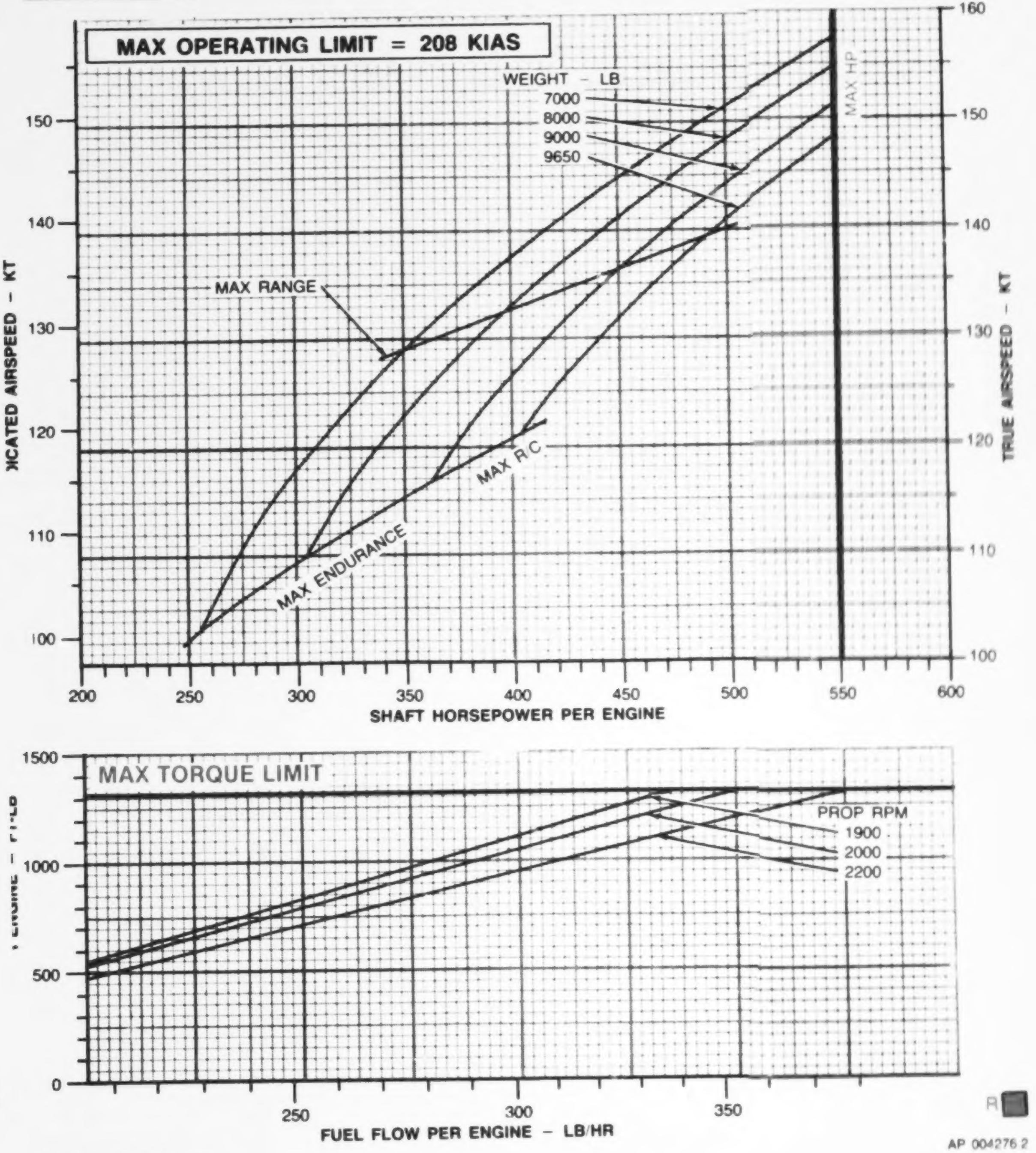
Figure 7-78. Cruise FAT 10°C, Sea Level **RU-21D** *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21D
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



AP 004276 2

A BASIS: ESTIMATED

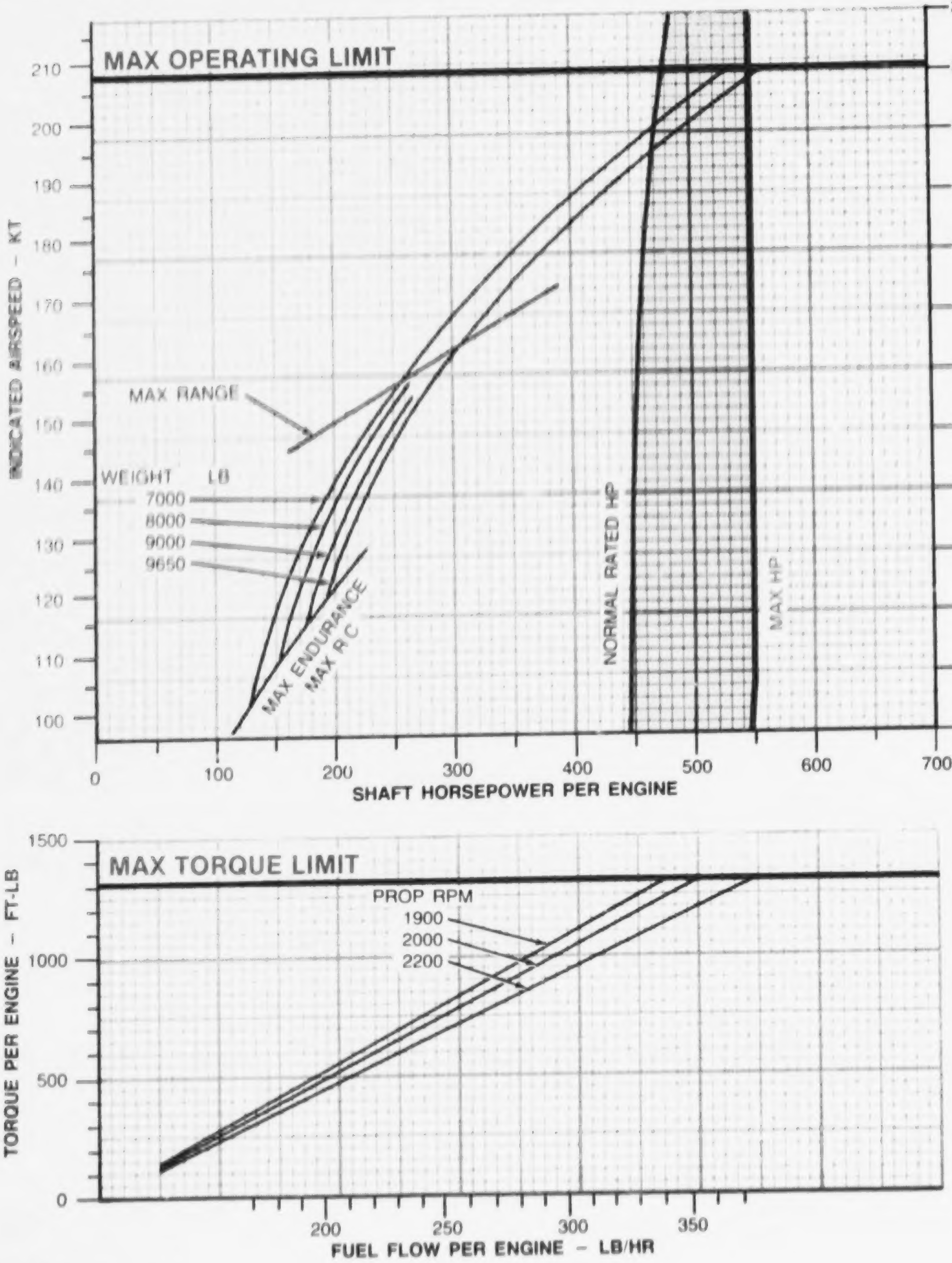
Figure 7-78. Cruise FAT 10°C, Sea Level **RU-21D** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 20°C



DATA BASIS: ESTIMATED

AP 004277 1

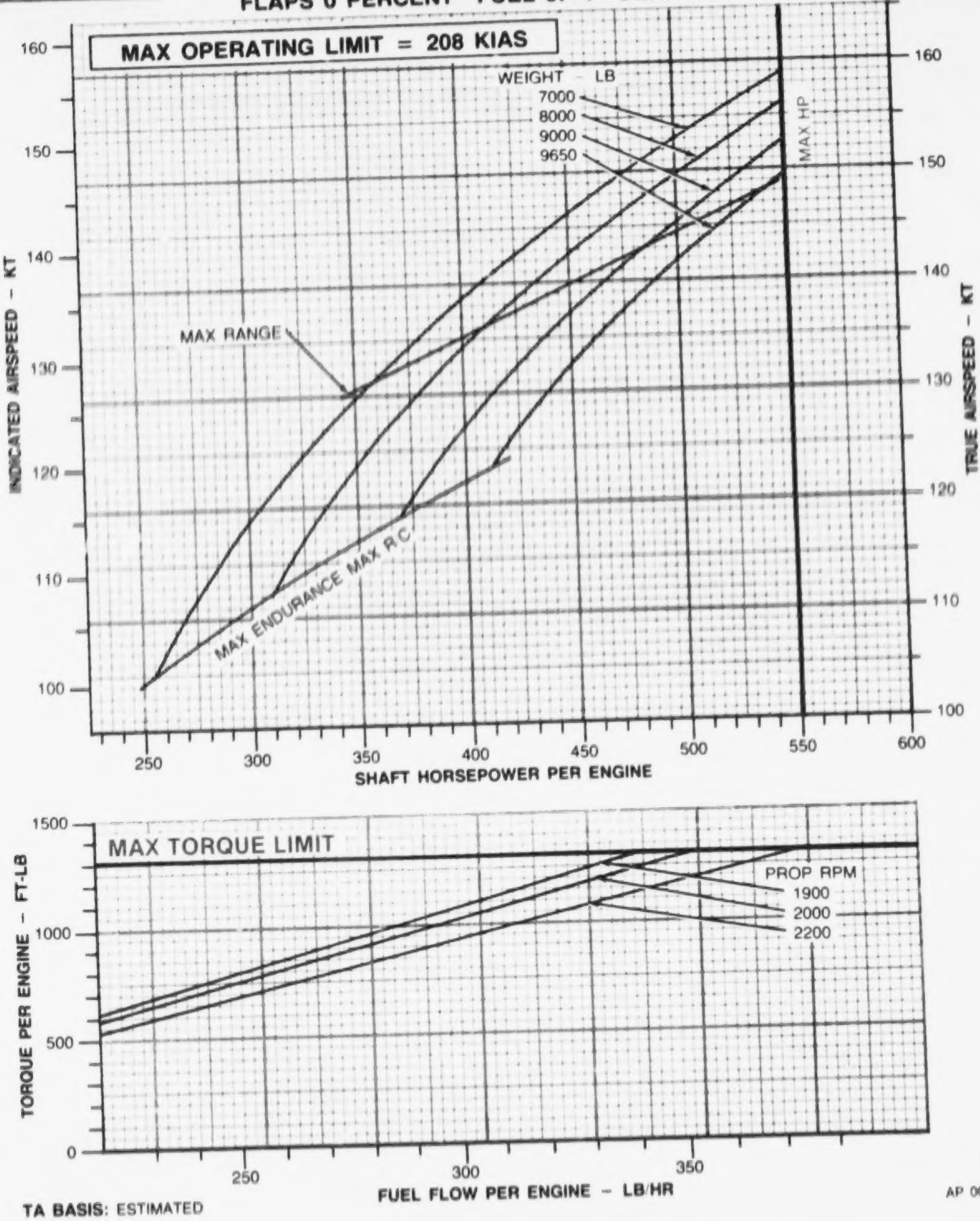
Figure 7-79. Cruise FAT 20°C, Sea Level **RU-21D** *(Sheet 1 of 2)*

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C

CRUISE
RU-21D
T74-CP-700



TA BASIS: ESTIMATED

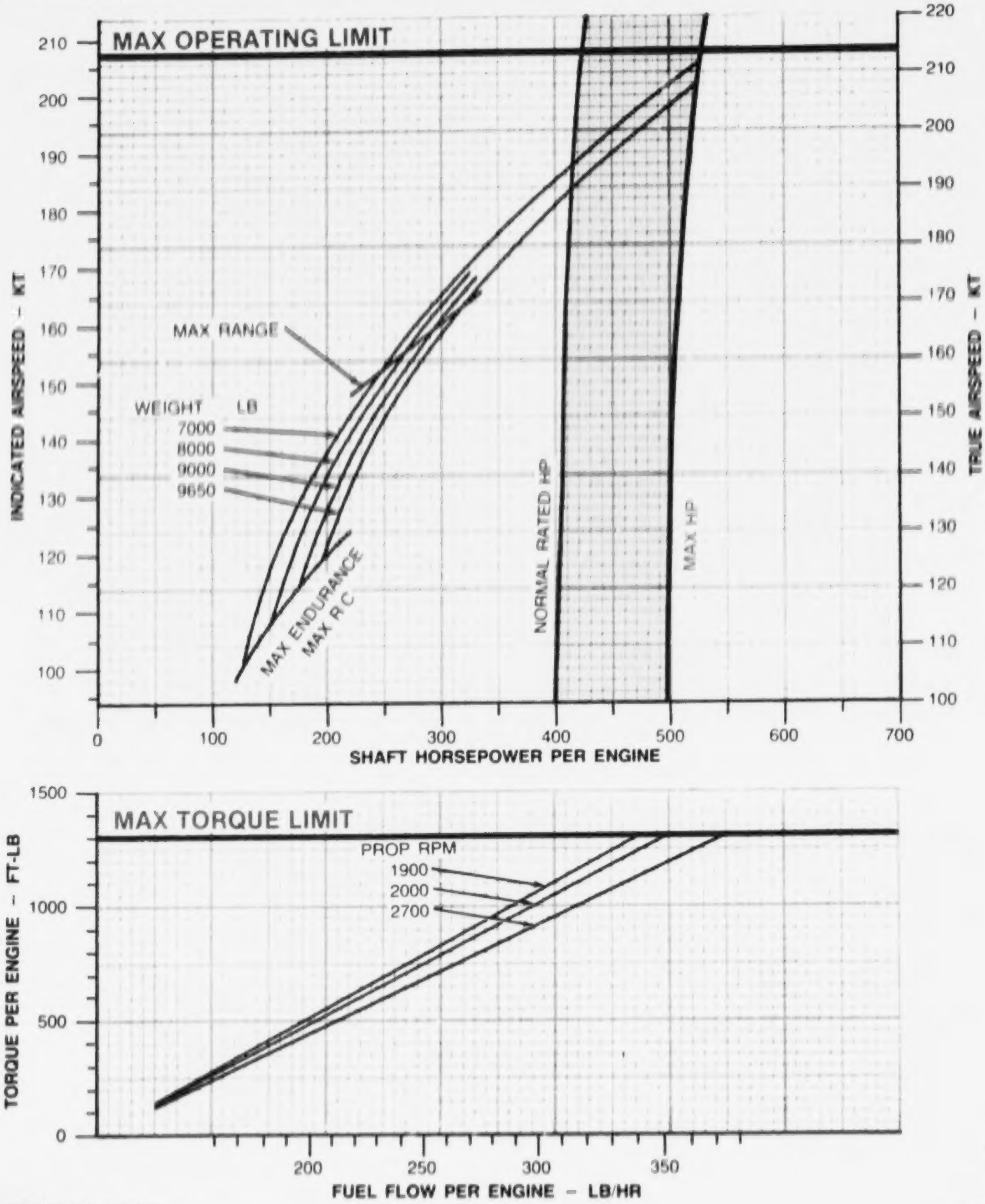
Figure 7-79. Cruise FAT 20°C, Sea Level **RU-21D** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 30°C



DATA BASIS: ESTIMATED

AP 004278 1

R

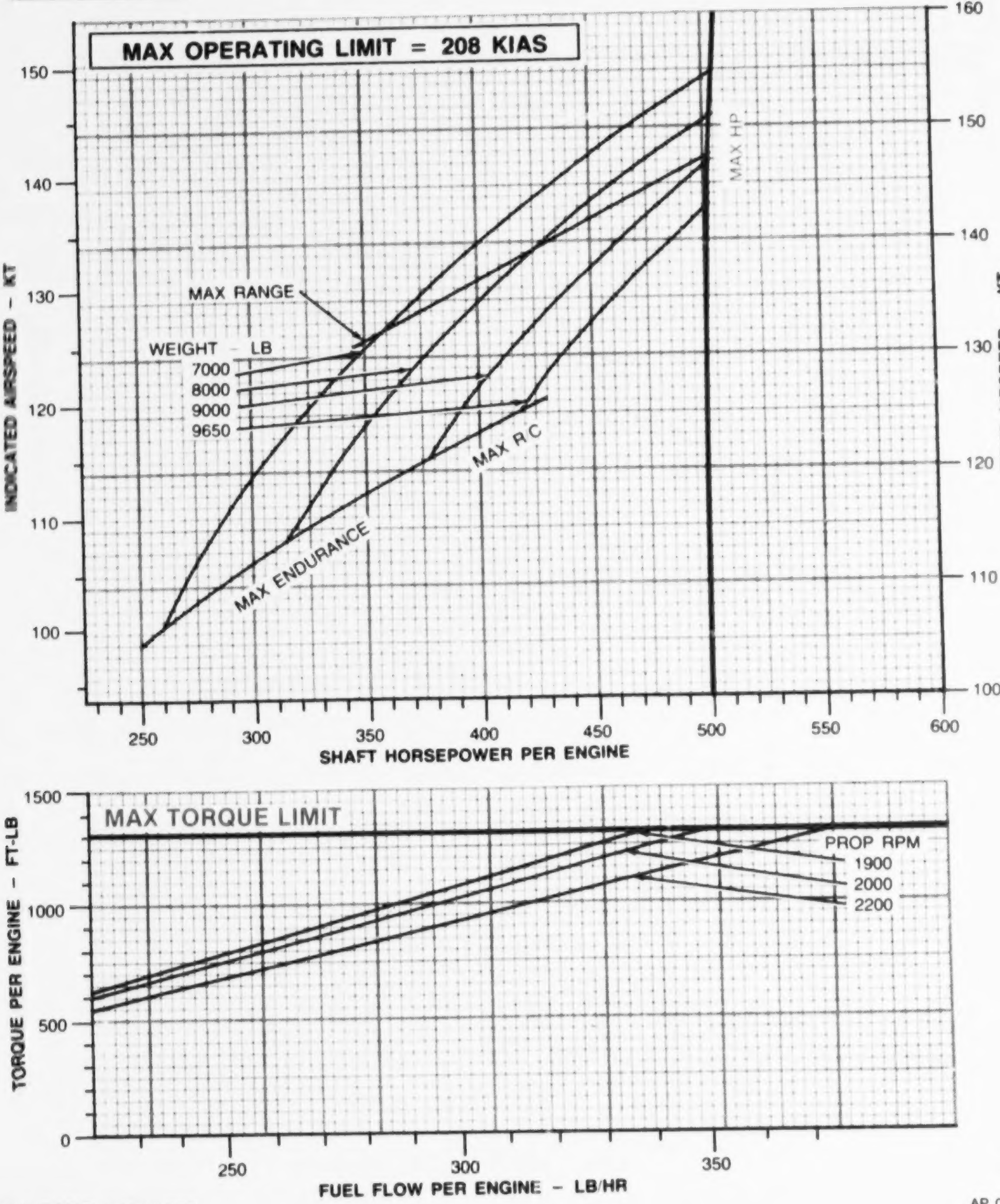
Figure 7-80. Cruise FAT 30°C, Sea Level RU-21D *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21D
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 30°C



DATA BASIS: ESTIMATED

AP 004278 2

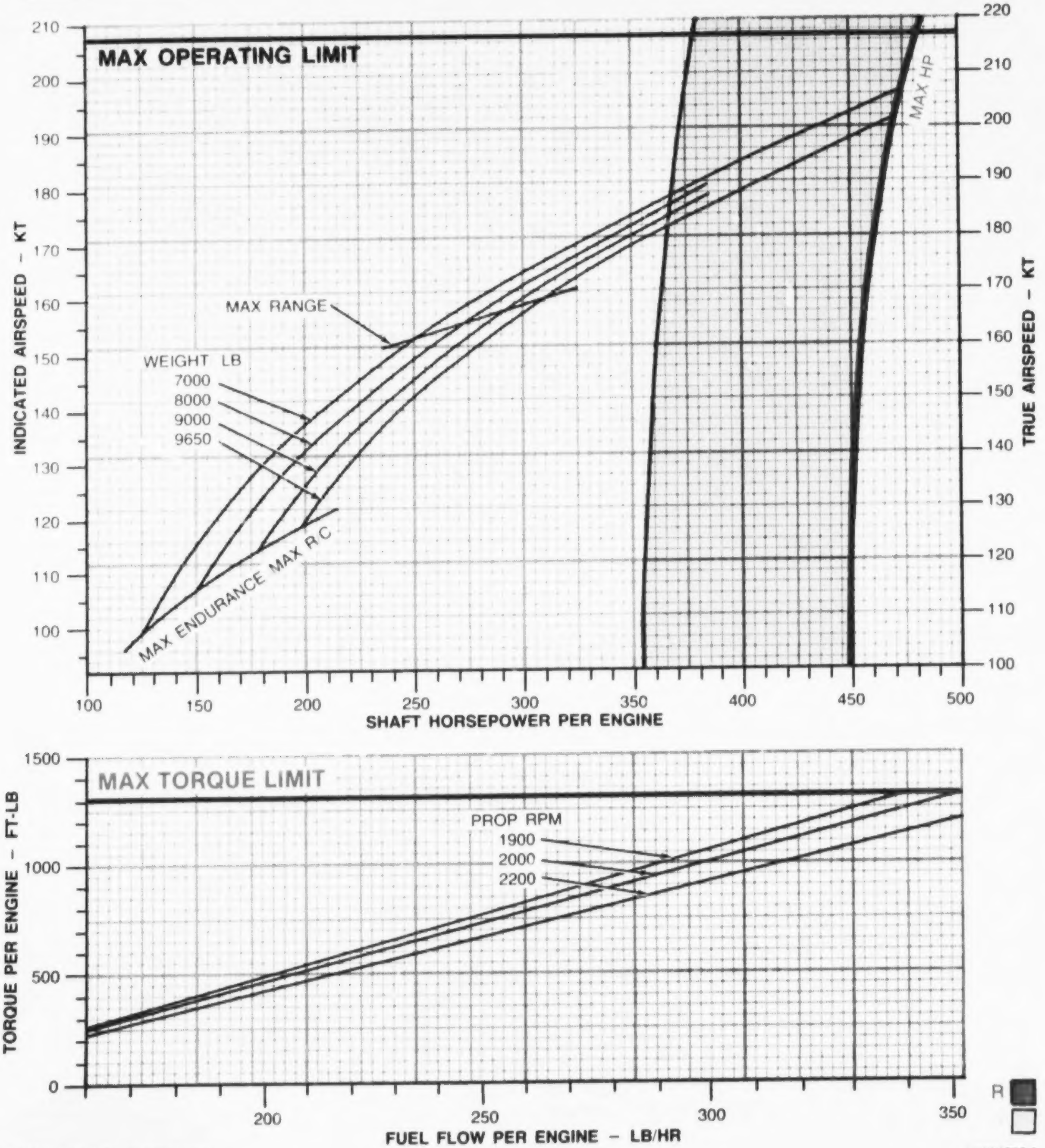
Figure 7-80. Cruise FAT 30°C, Sea Level RU-21D *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 40°C



DATA BASIS: ESTIMATED

AP004279 1

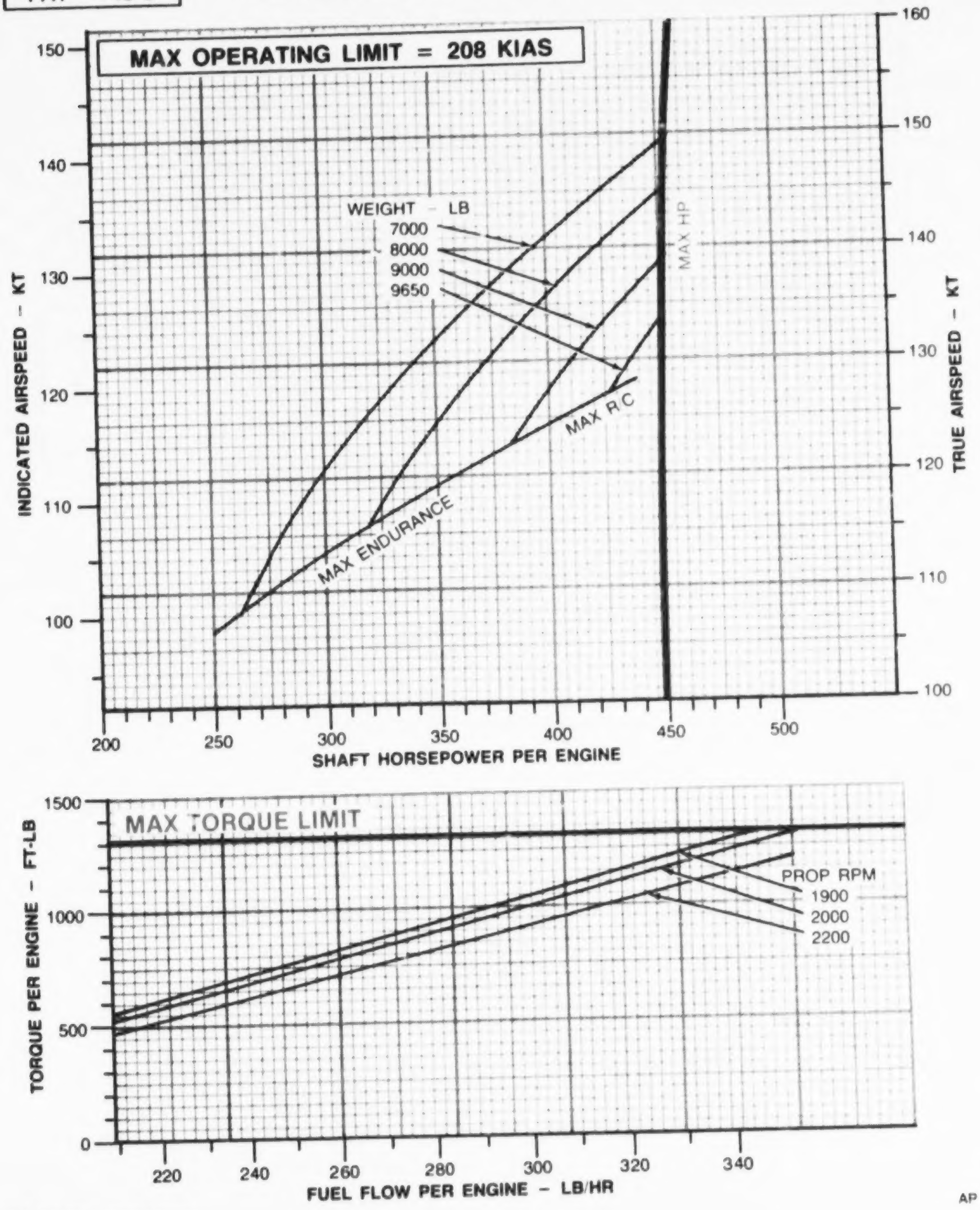
Figure 7-81. Cruise FAT 40°C, Sea Level RU-21D *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21D
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 40°C



AP 004279 2

DATA BASIS: ESTIMATED

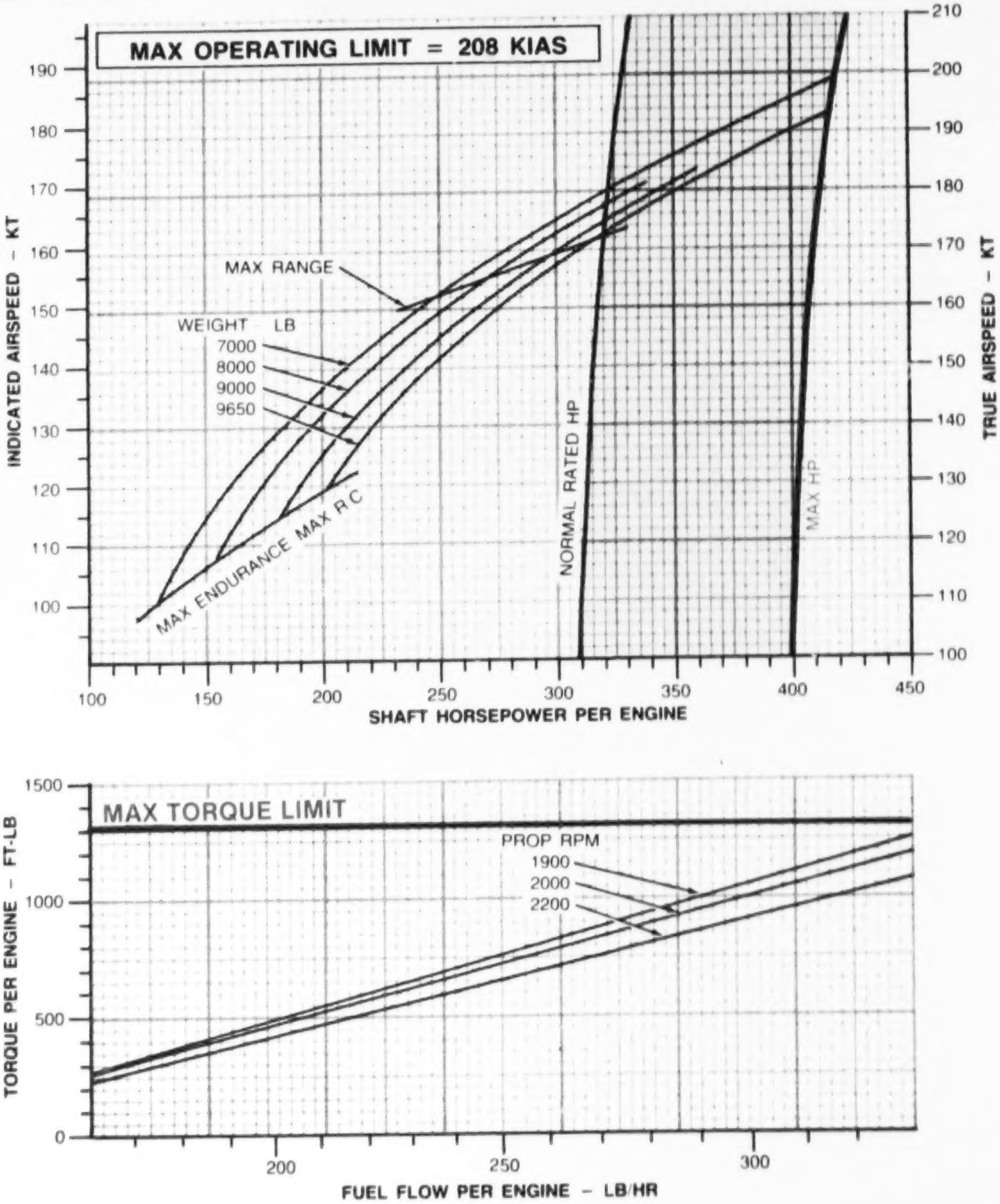
Figure 7-81. Cruise FAT 40°C, Sea Level RU-21D *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 50°C



DATA BASIS: ESTIMATED

AP 004280

Figure 7-82. Cruise FAT 50°C, Sea Level RU-21D

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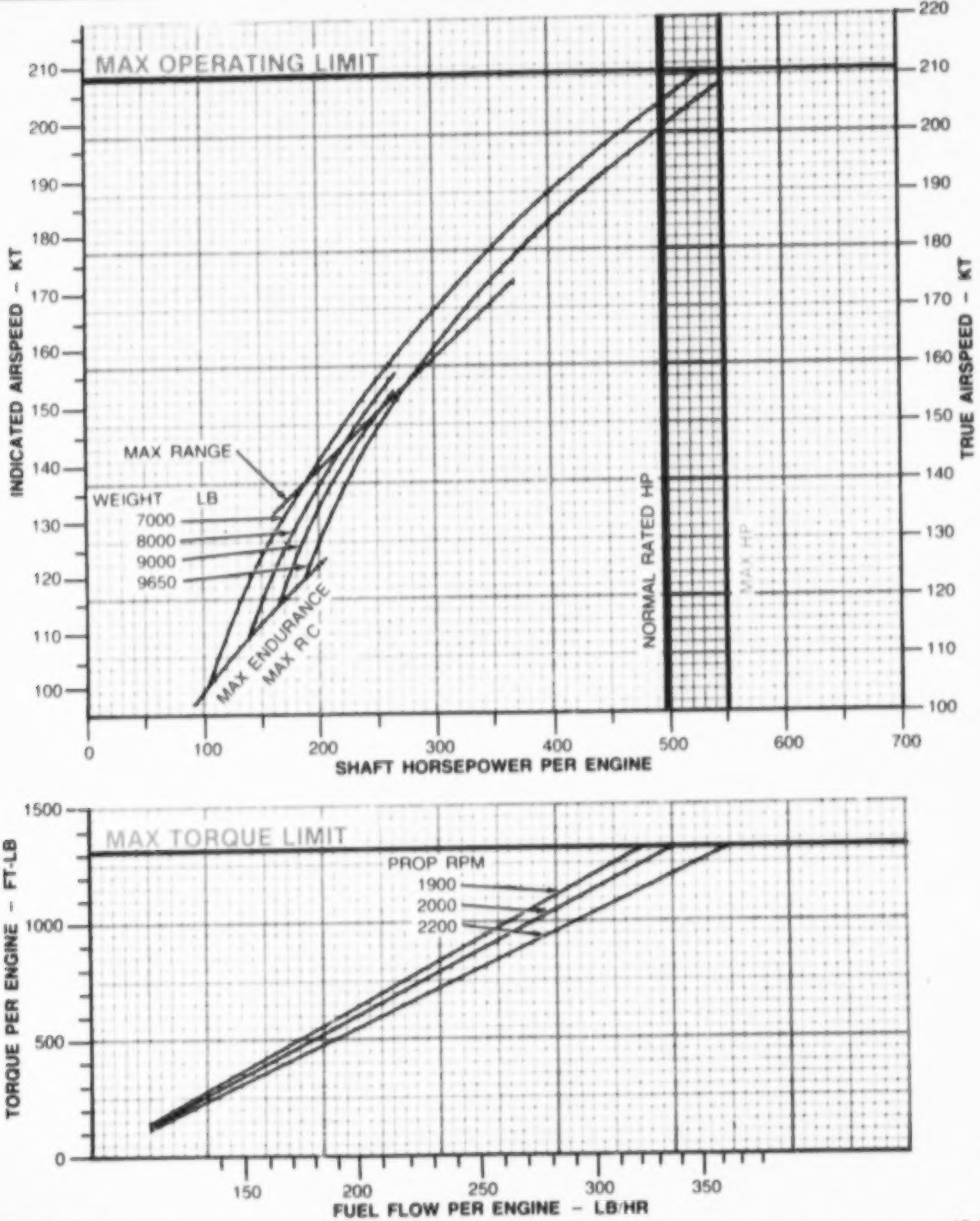
☐

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = −20°C



DATA BASIS: ESTIMATED

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AP 004291.1

Figure 7-83. Cruise FAT −20°C, 4000 Ft (RU-21D) RU-21D

CRUISE
RU-21D
T74-CP-700

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C

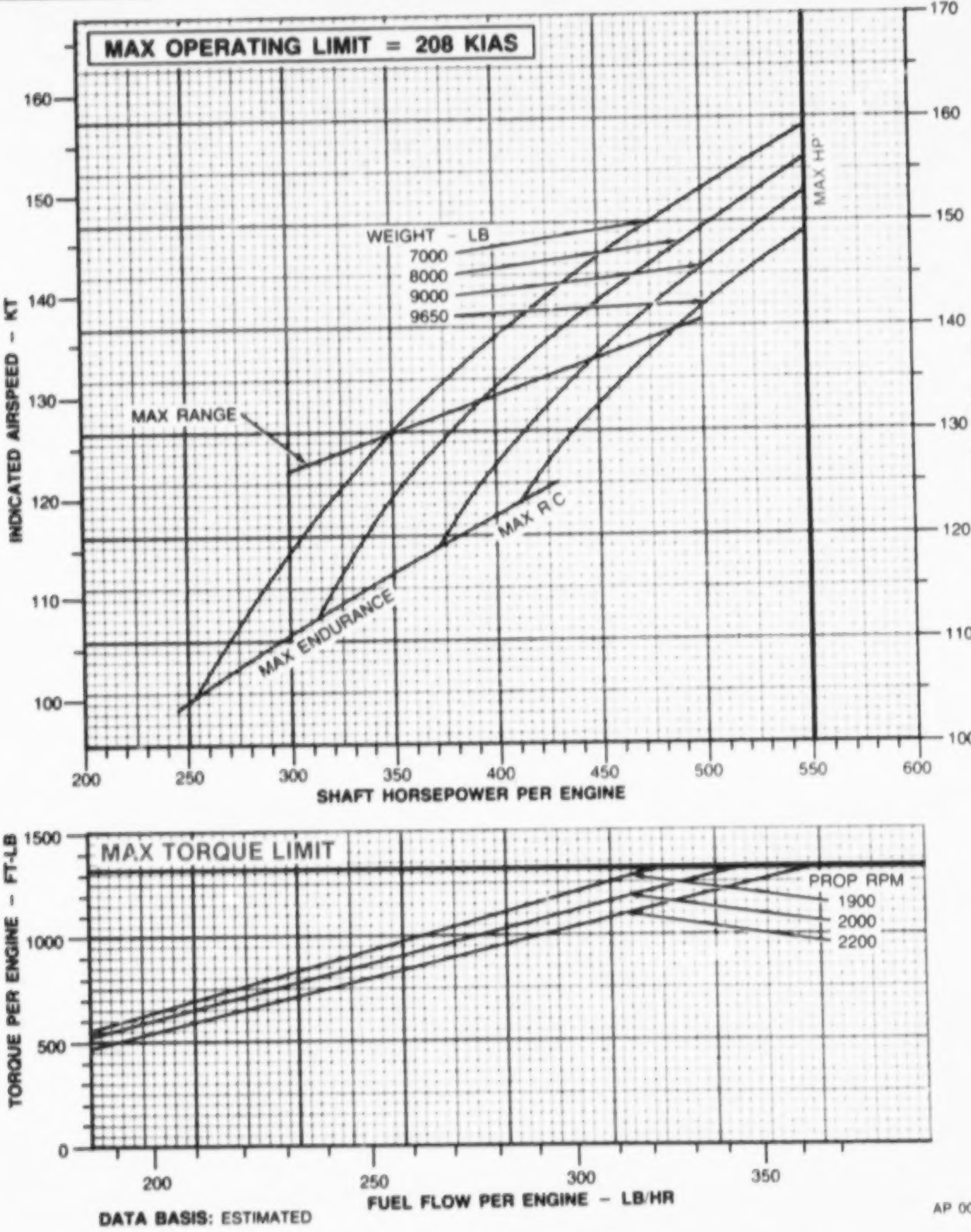


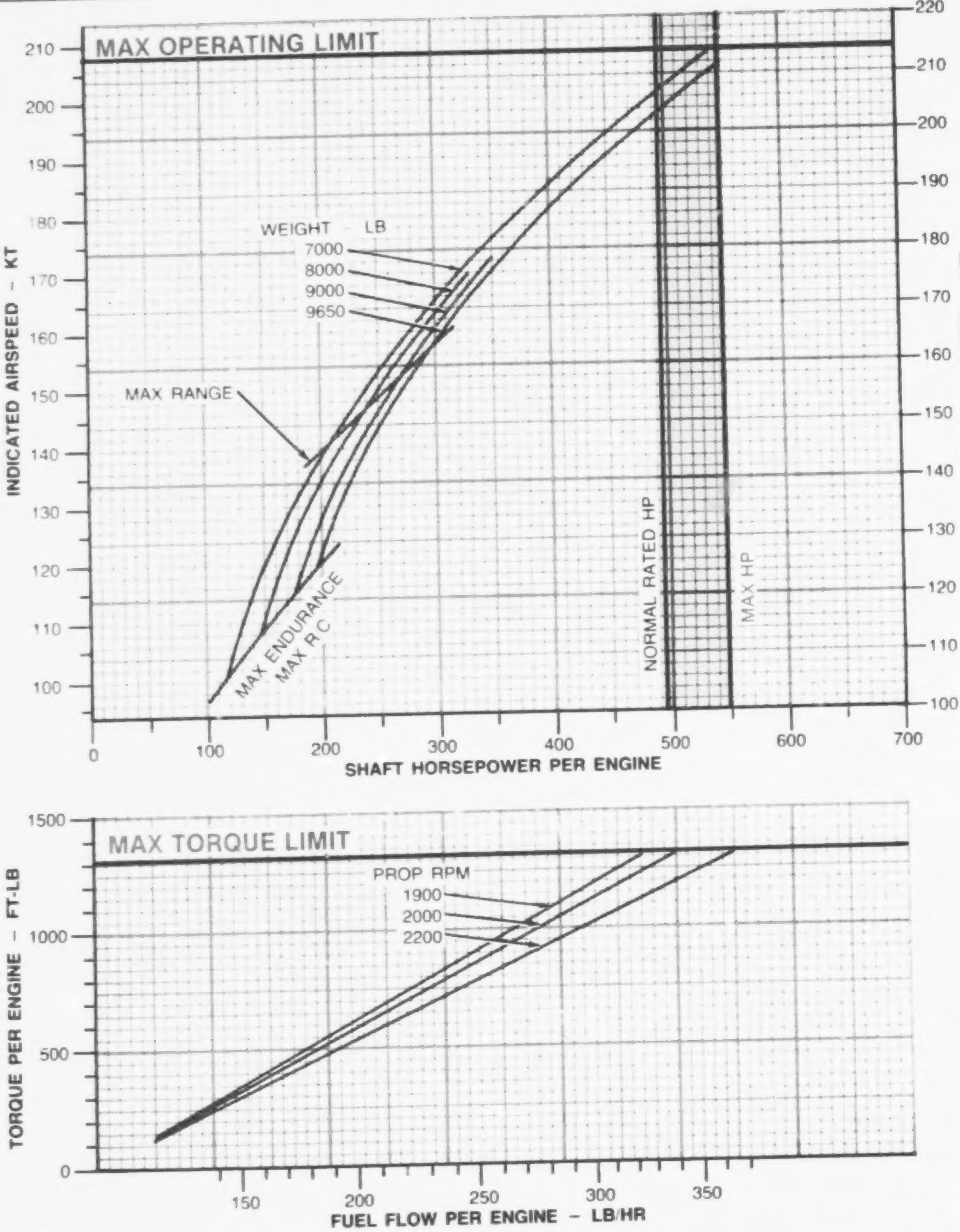
Figure 7-83. Cruise FAT −20°C, 4000 Ft **RU-21D** *(Sheet 2 of 2)*

CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



DATA BASIS: ESTIMATED

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AP 004292 1

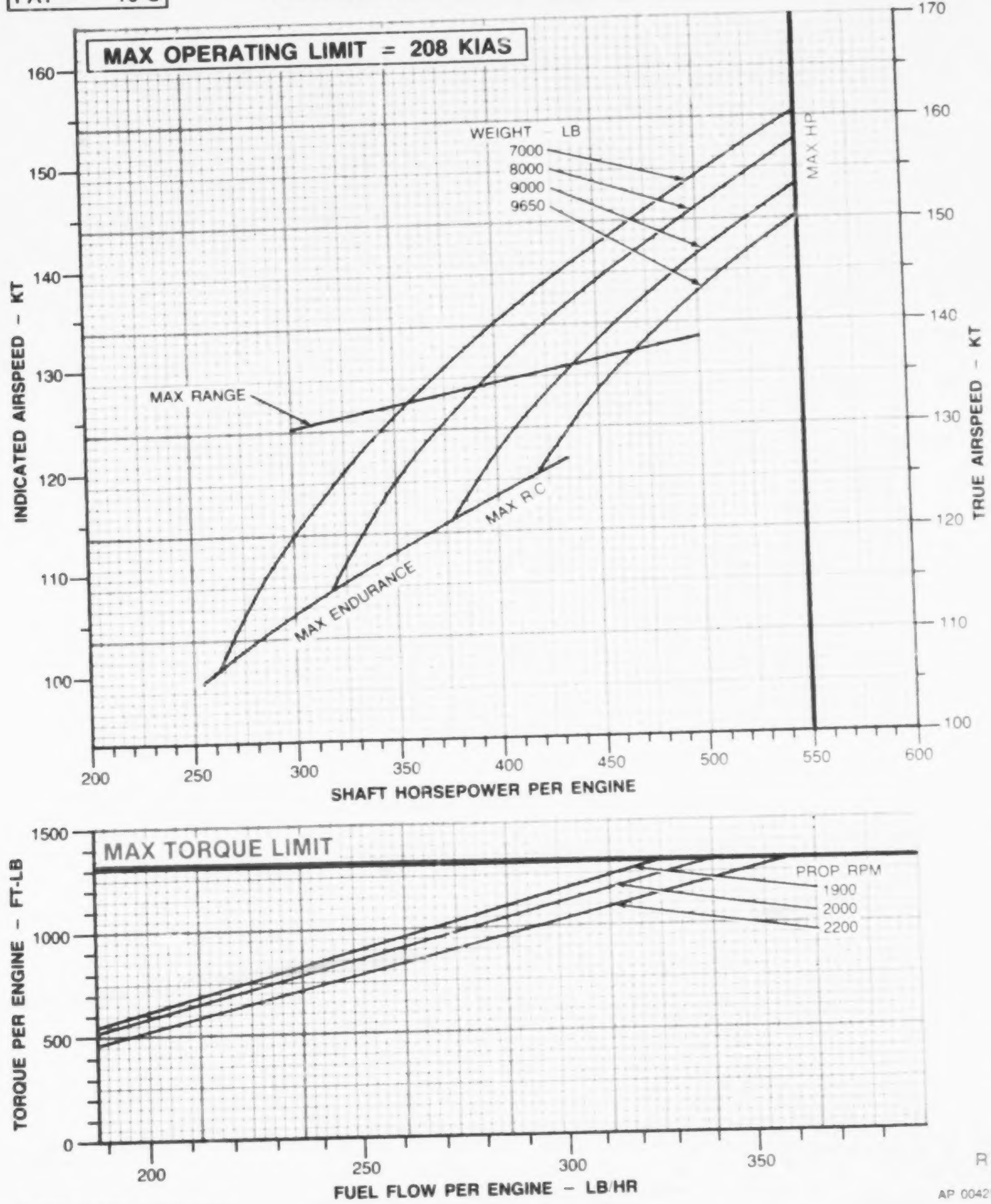
Figure 7-84. Cruise FAT −10°C, 4000 Ft RU-21D (Sheet 1 of 2)

CRUISE

CRUISE
RU-21D
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



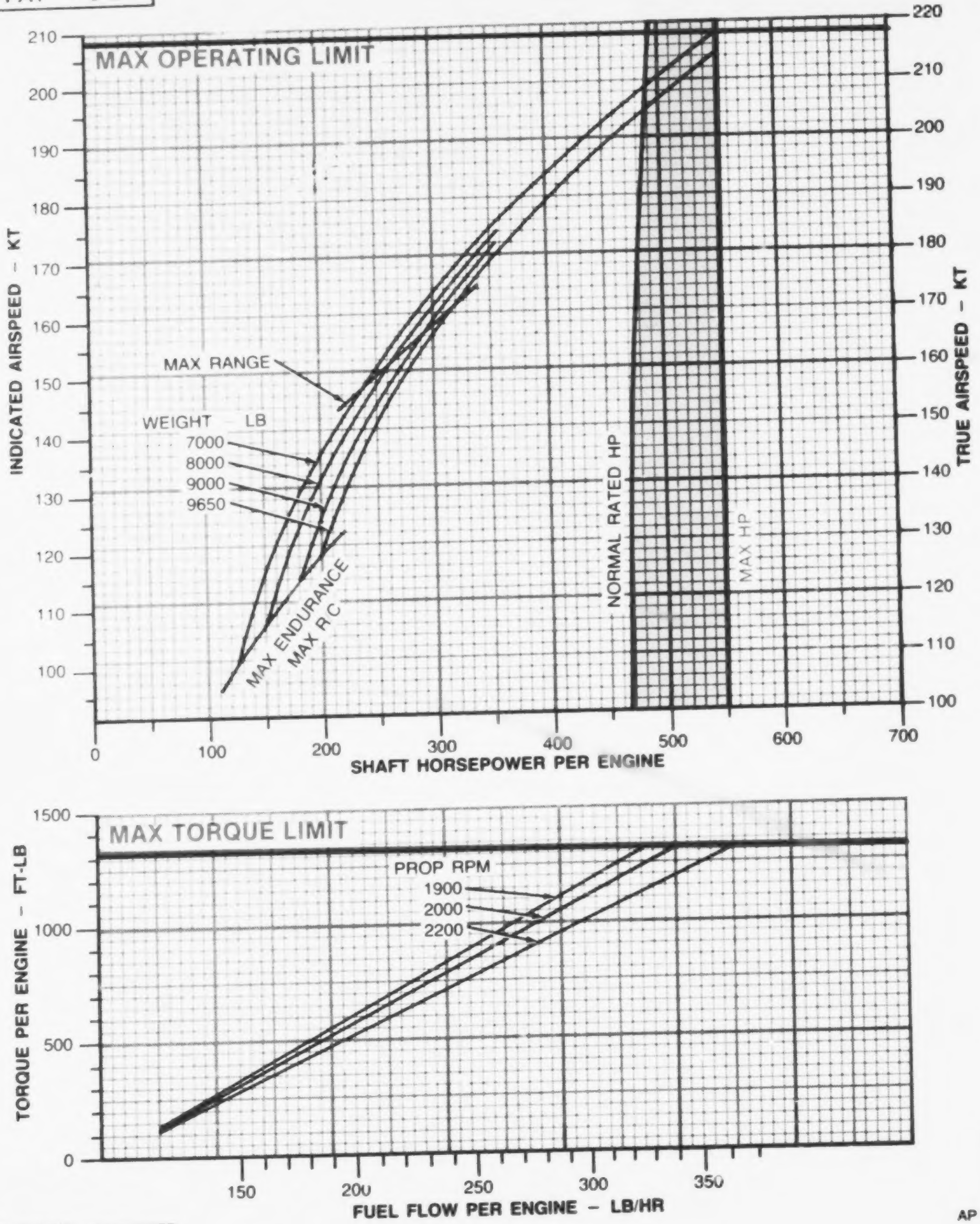
DATA BASIS: ESTIMATED

Figure 7-84. Cruise FAT −10°C, 4000 Ft **RU-21D** *(Sheet 2 of 2)*

CRUISE
TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 0°C



DATA BASIS: ESTIMATED

AP 004293.1

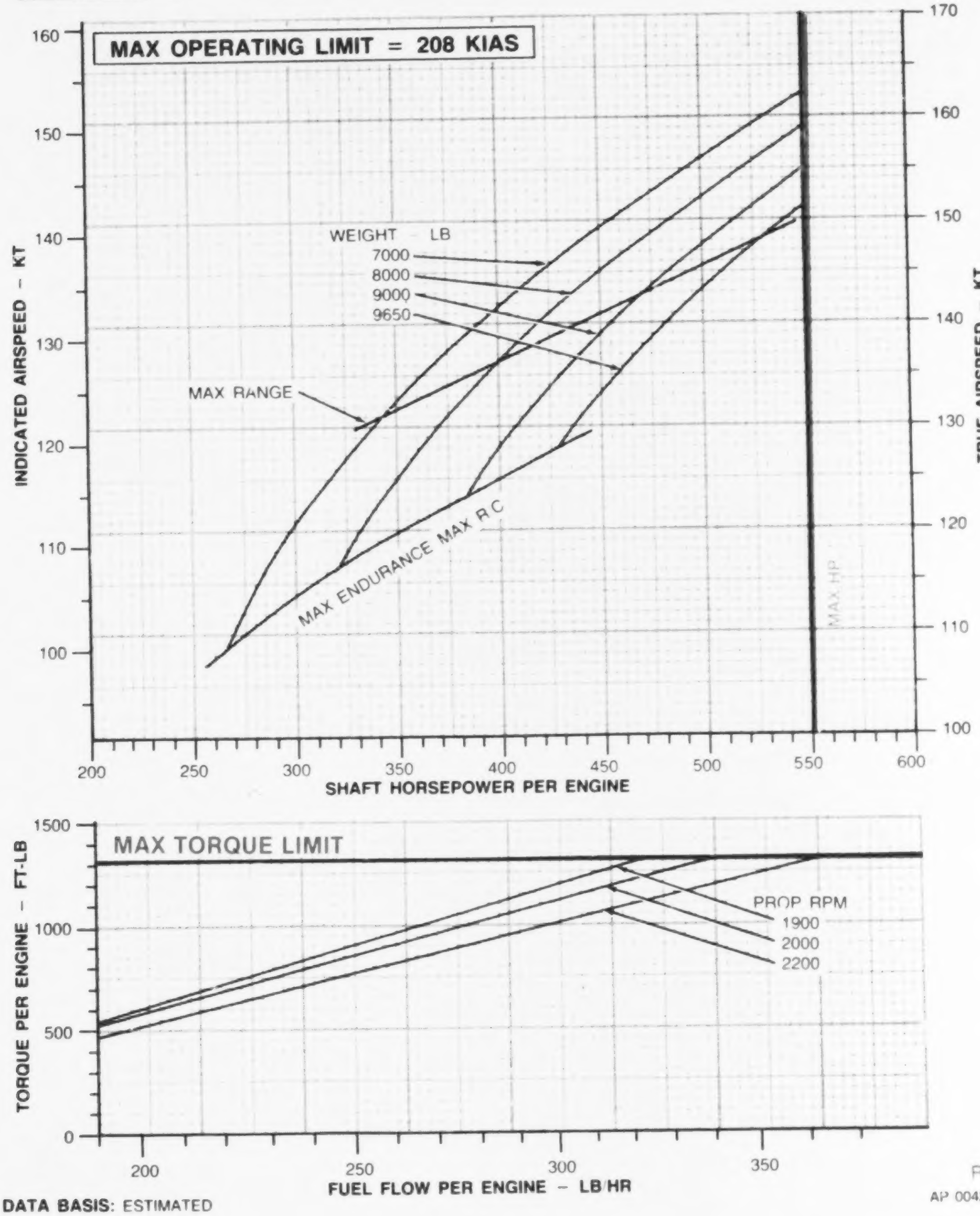
Figure 7-85. Cruise FAT 0°C, 4000 Ft **RU-21D** *(Sheet 1 of 2)*

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 0°C



DATA BASIS: ESTIMATED

AP 004293 2

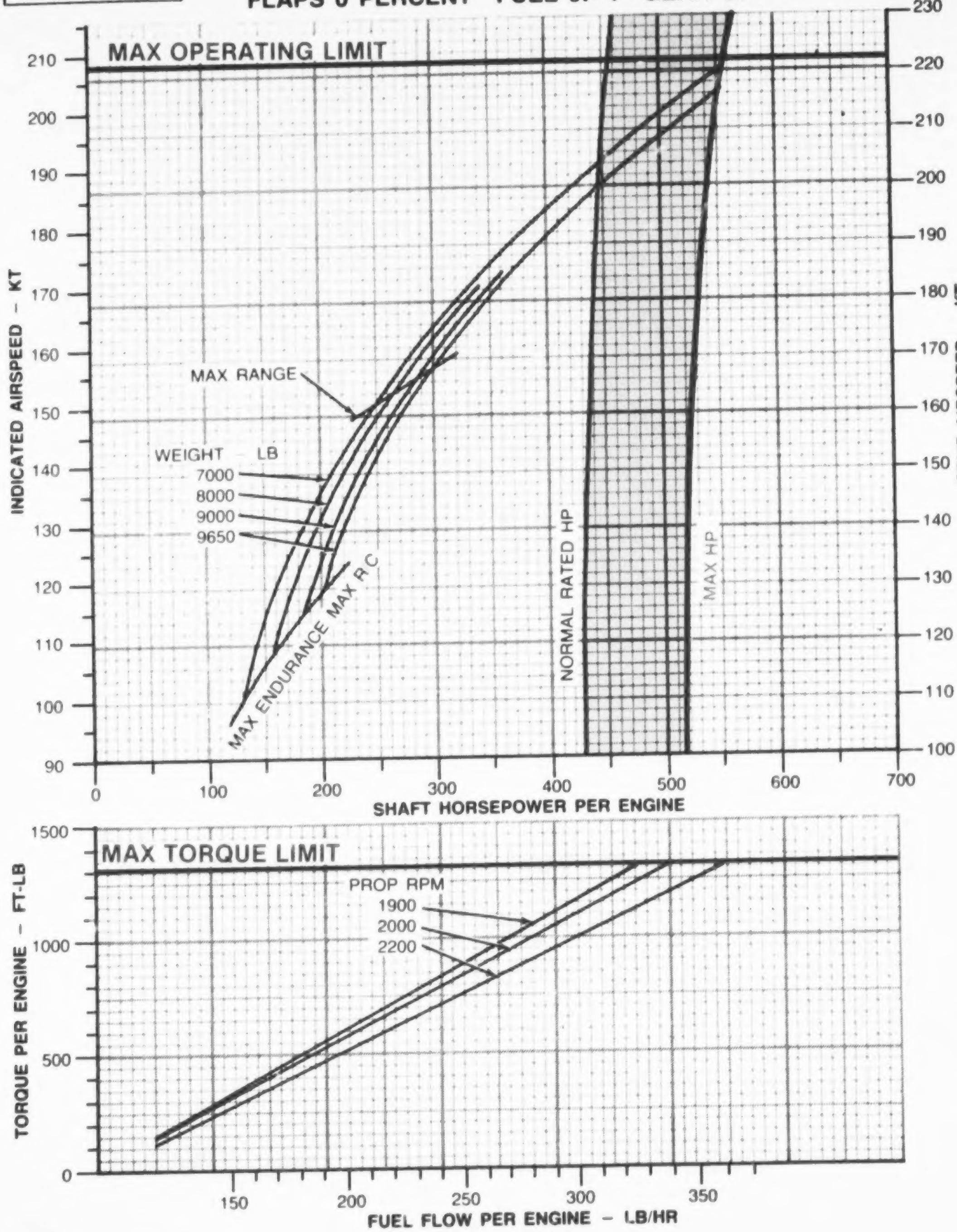
Figure 7-85. Cruise FAT 0°C, 4000 Ft **RU-21D** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 10°C



DATA BASIS: ESTIMATED

AP 004294 1

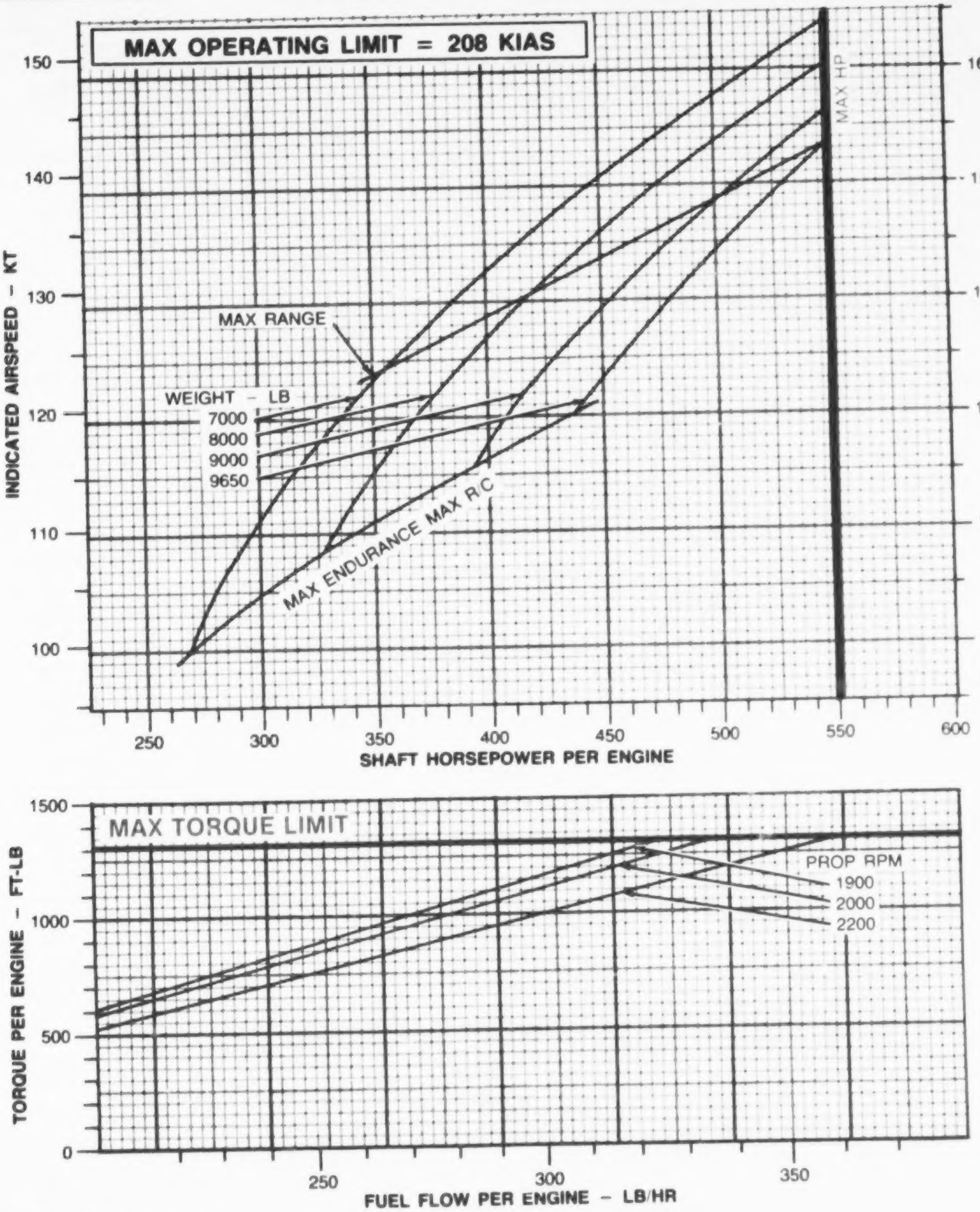
Figure 7-86. Cruise FAT 10°C, 4000 Ft RU-21D *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21D
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



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DATA BASIS: ESTIMATED

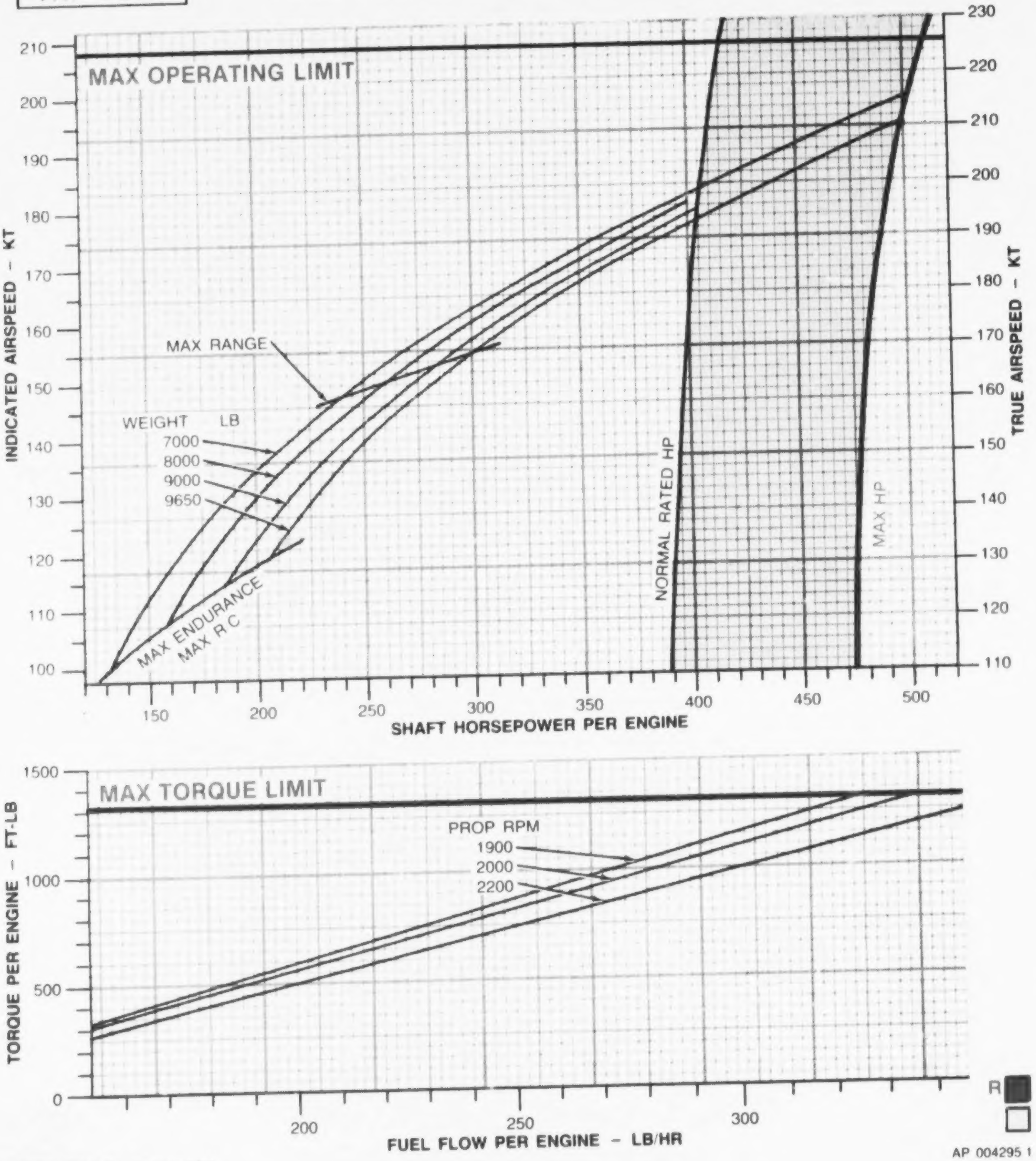
AP 004294 2

Figure 7-86. Cruise FAT 10°C, 4000 Ft **RU-21D** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C



AP 004295 1

DATA BASIS: ESTIMATED

Figure 7-87. Cruise FAT 20°C, 4000 Ft RU-21D

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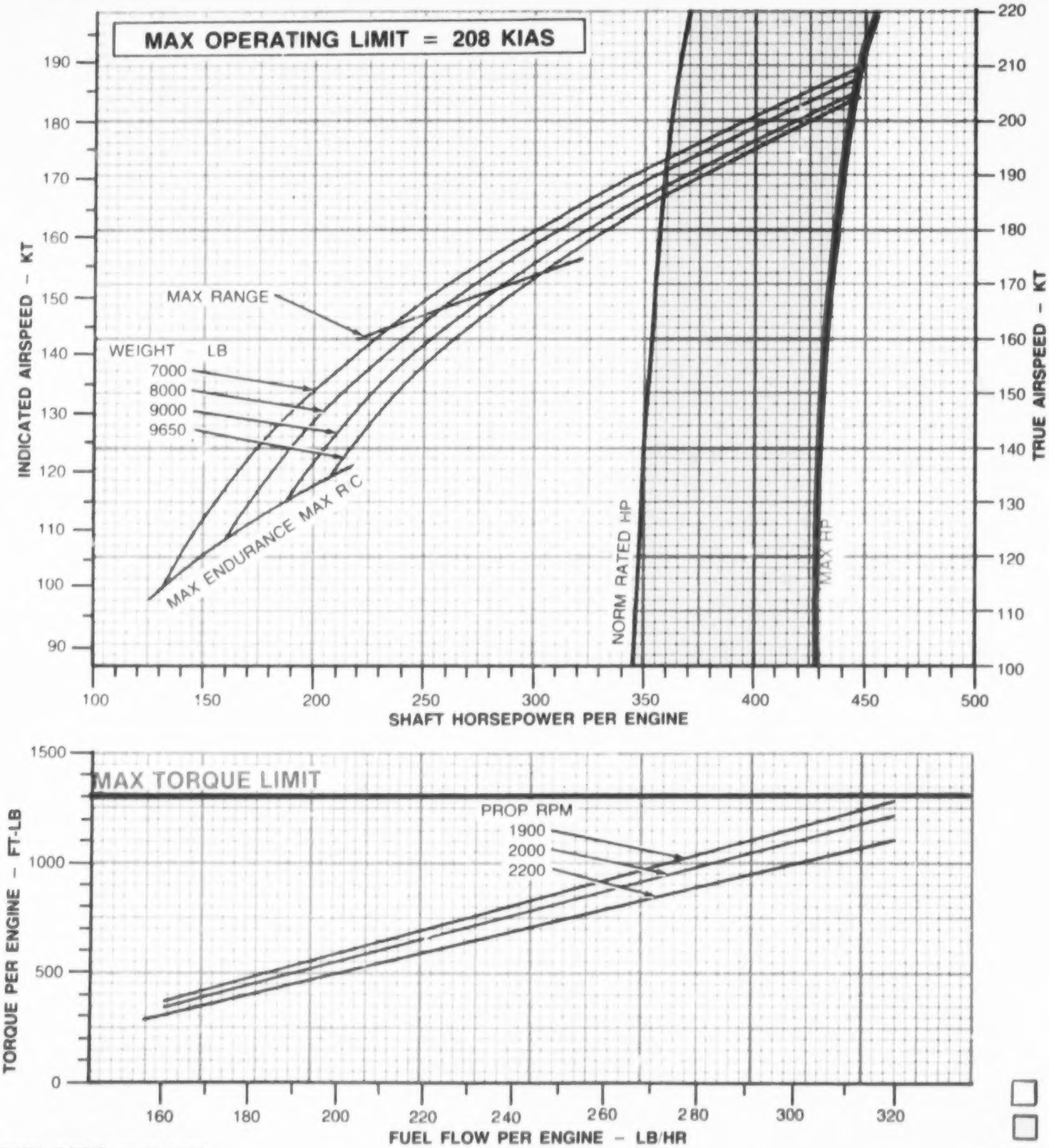
CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 30°C



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DATA BASIS: ESTIMATED

AP 004296

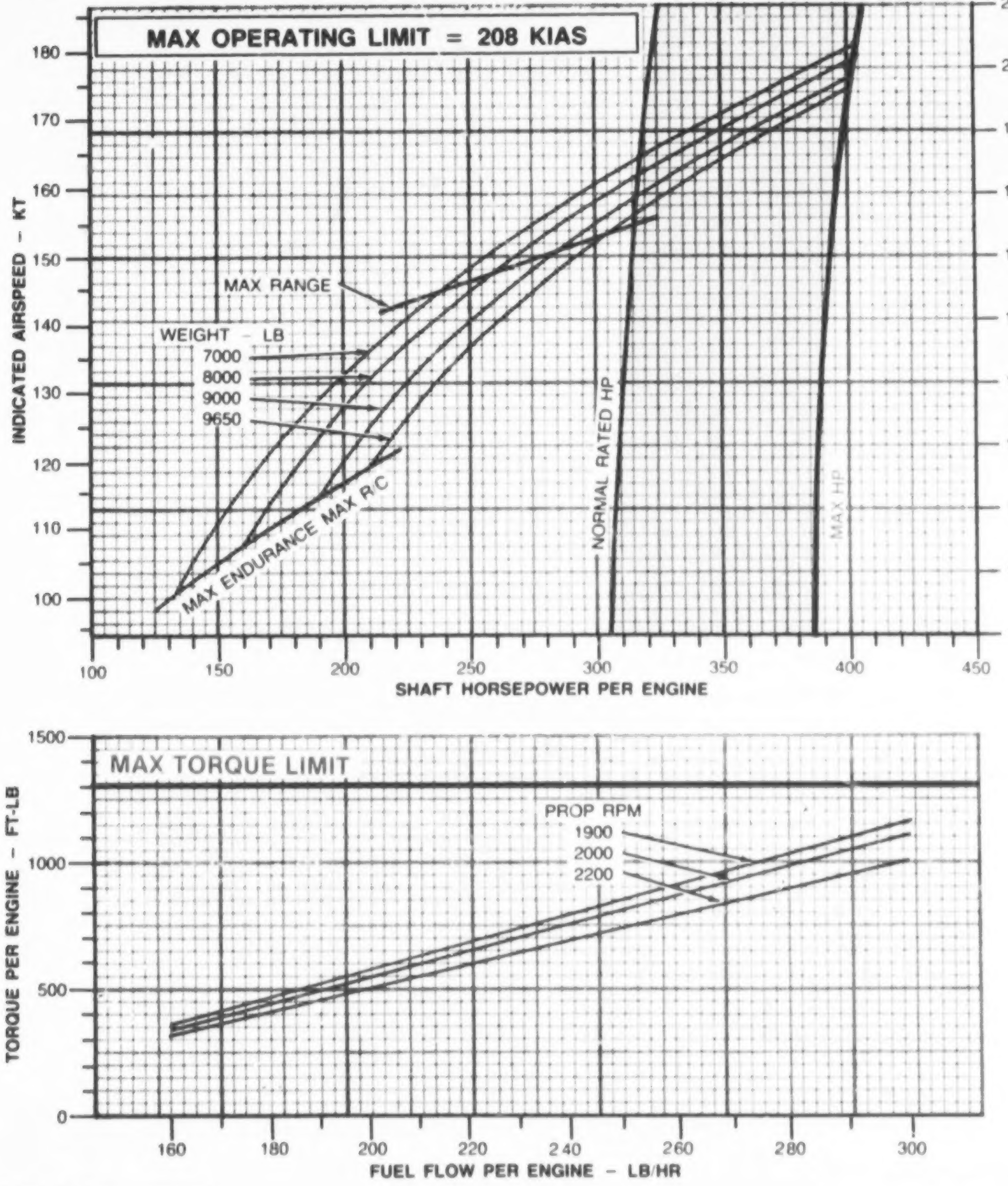
Figure 7-88. Cruise FAT 30°C, 4000 Ft **RU-21D**

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 4000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 40°C



DATA BASIS: ESTIMATED

AP 004297

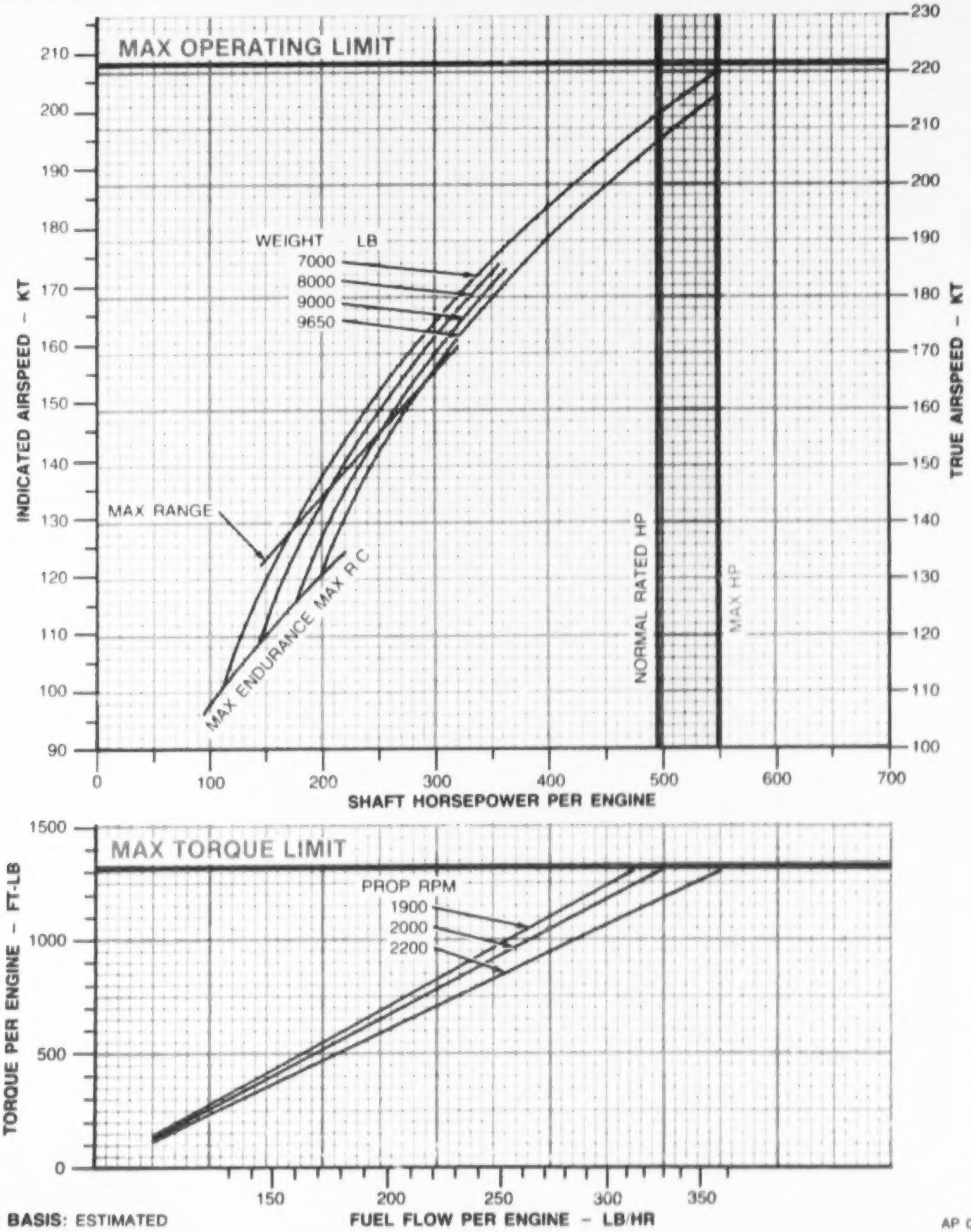
Figure 7-89. Cruise FAT 40°C, 4000 Ft RU-21D

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C

CRUISE
RU-21D
T74-CP-700



DATA BASIS: ESTIMATED

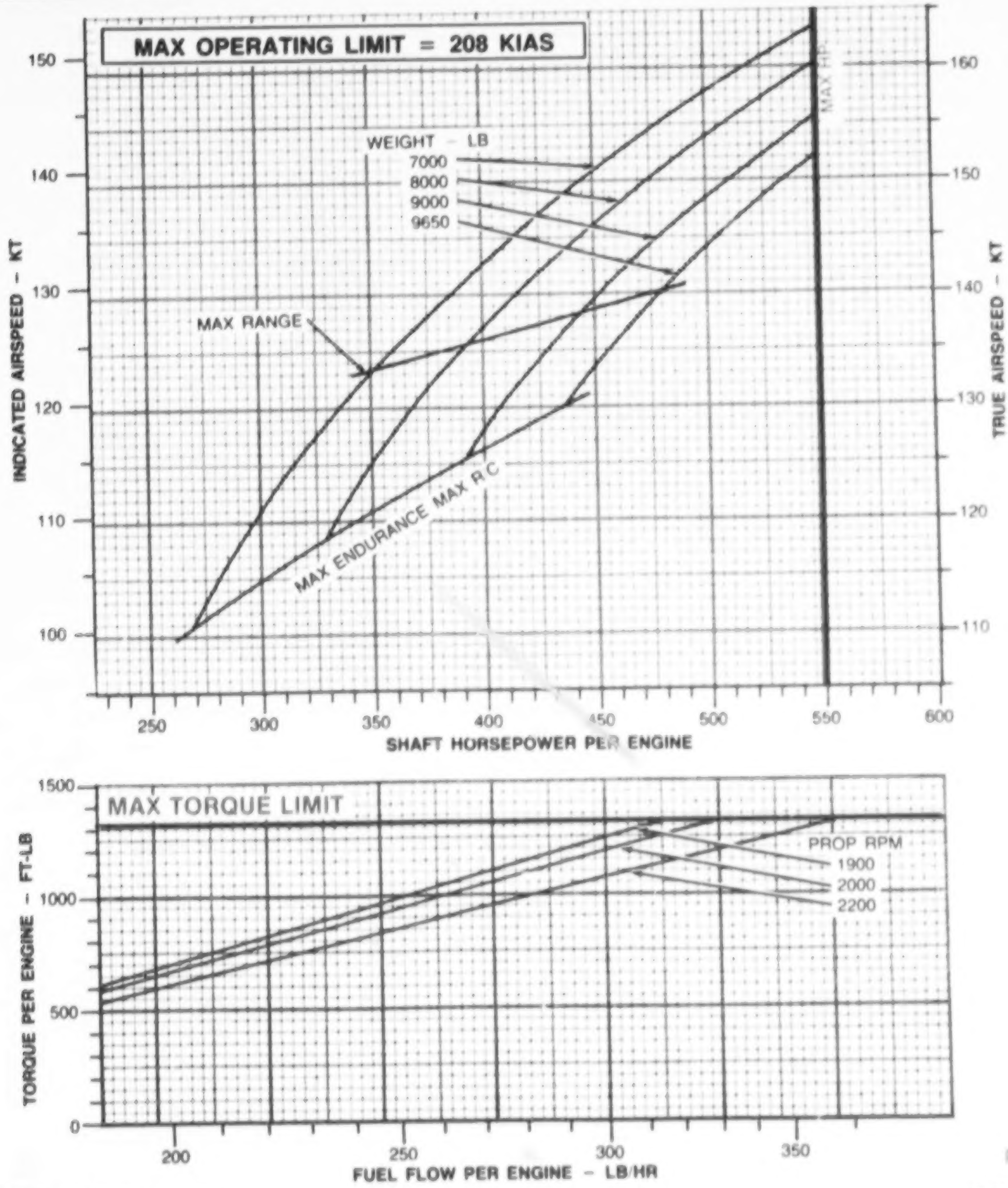
Figure 7-90. Cruise FAT −30°C, 8000 Ft RU-21D *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21D
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



DATA BASIS: ESTIMATED

Figure 7-90. Cruise FAT −30°C, 8000 Ft **RU-21D** *(Sheet 2 of 2)*

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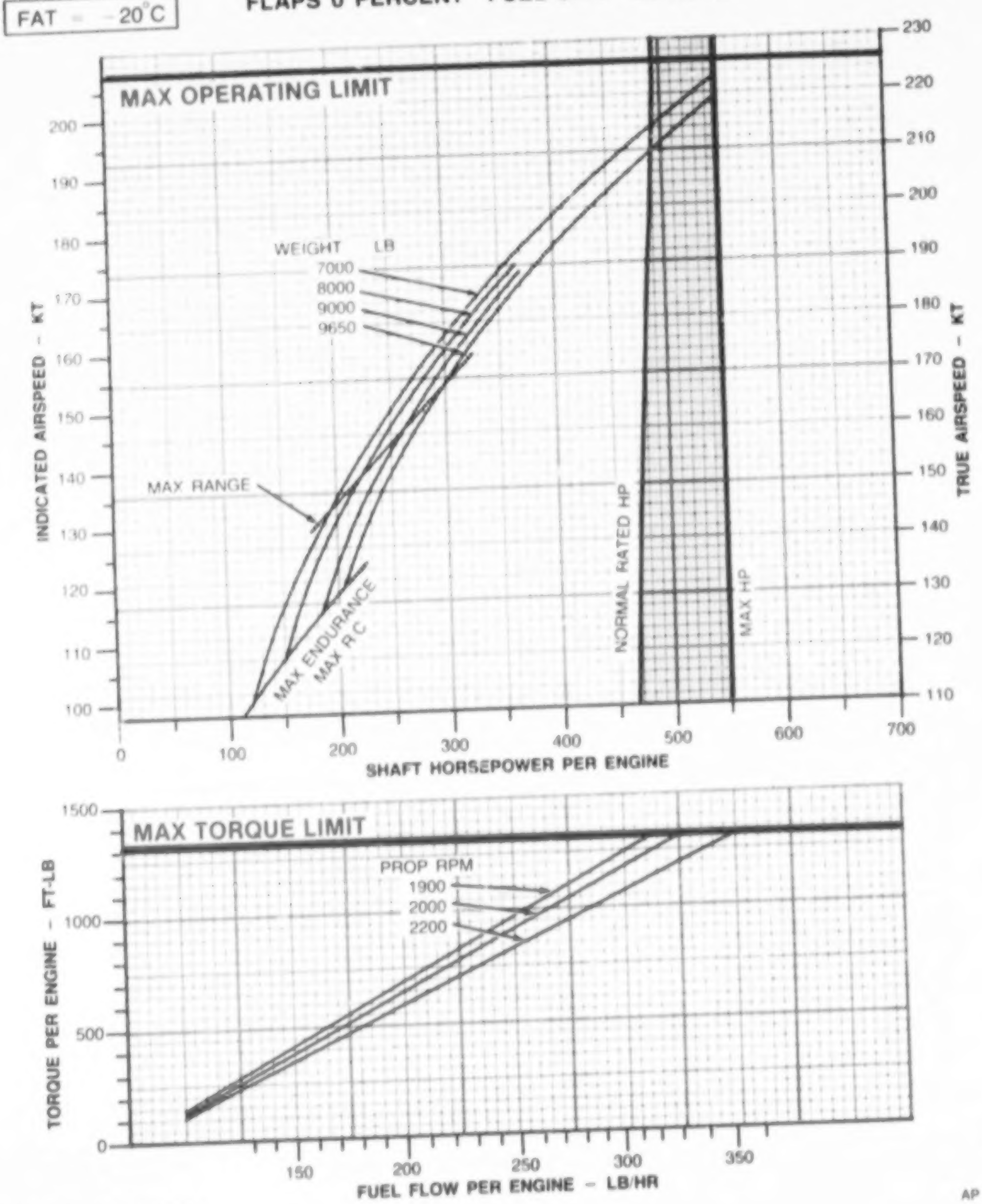
CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP



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AP 004299 1

DATA BASIS: ESTIMATED

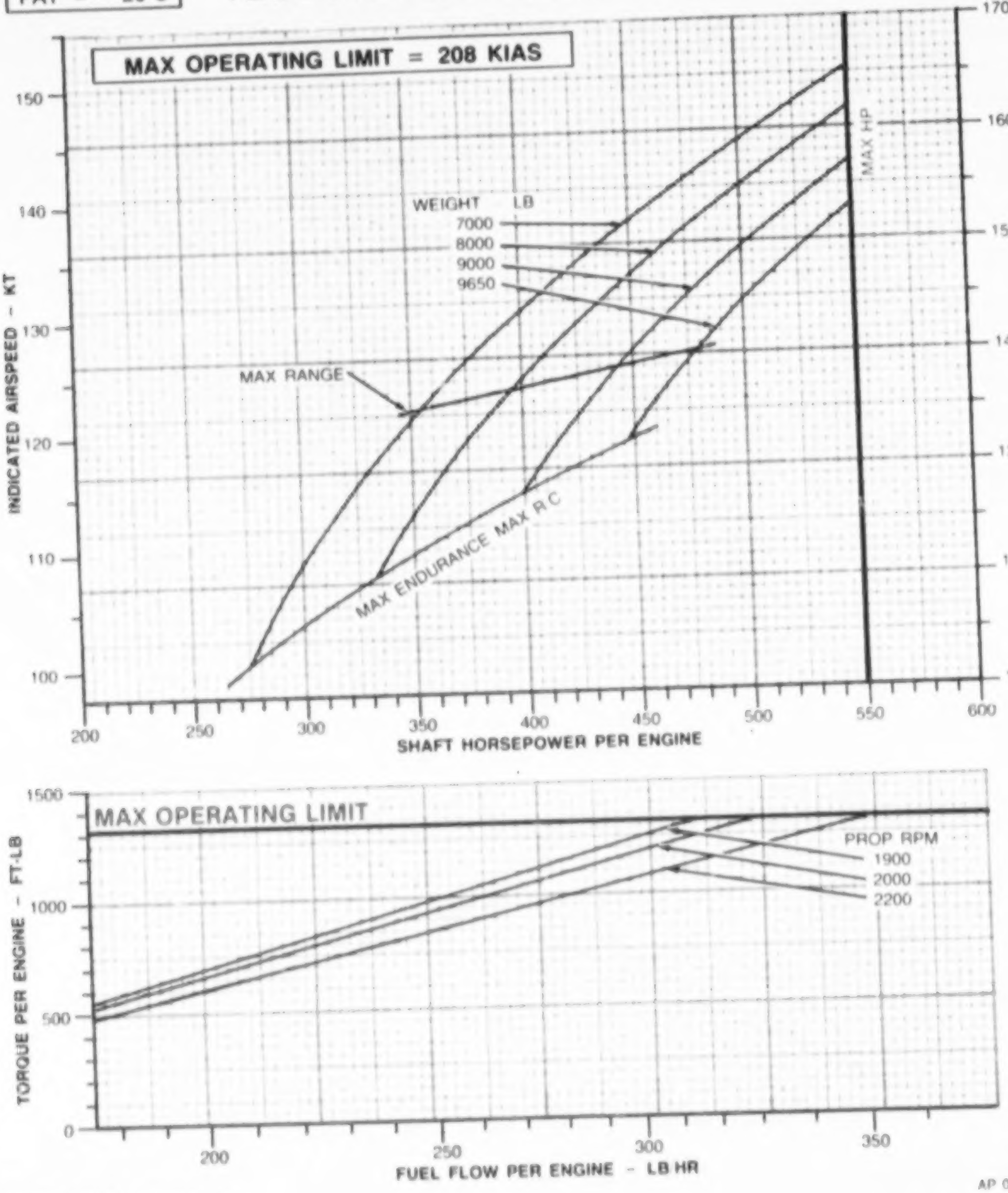
Figure 7-91. Cruise FAT −20°C, 8000 Ft **RU-21D** *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21D
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = -20°C



AP 004299 2

DATA BASIS: ESTIMATED

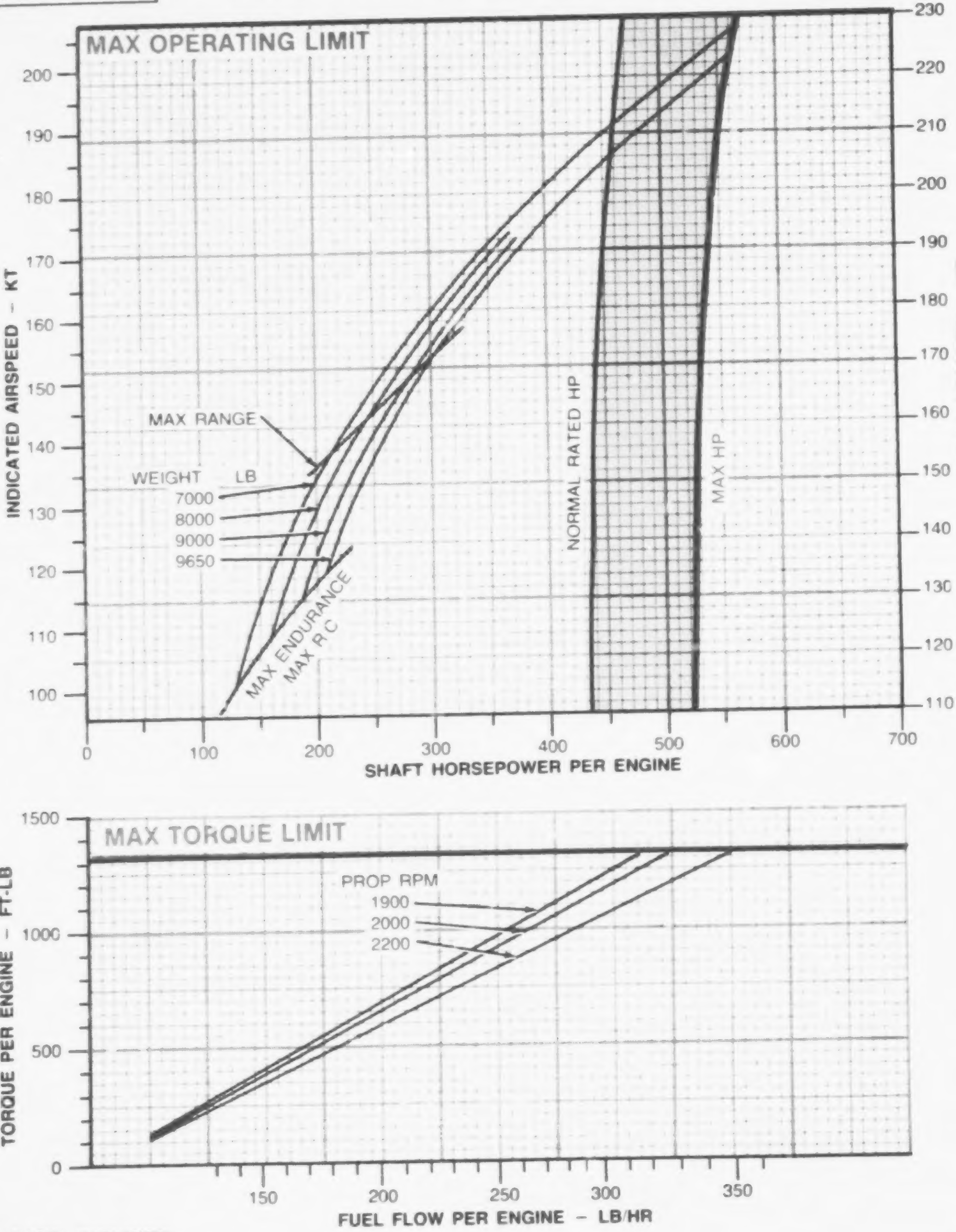
Figure 7-91. Cruise FAT -20°C, 8000 Ft RU-21D (Sheet 2 of 2)

CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



DATA BASIS: ESTIMATED

AP 004300 1

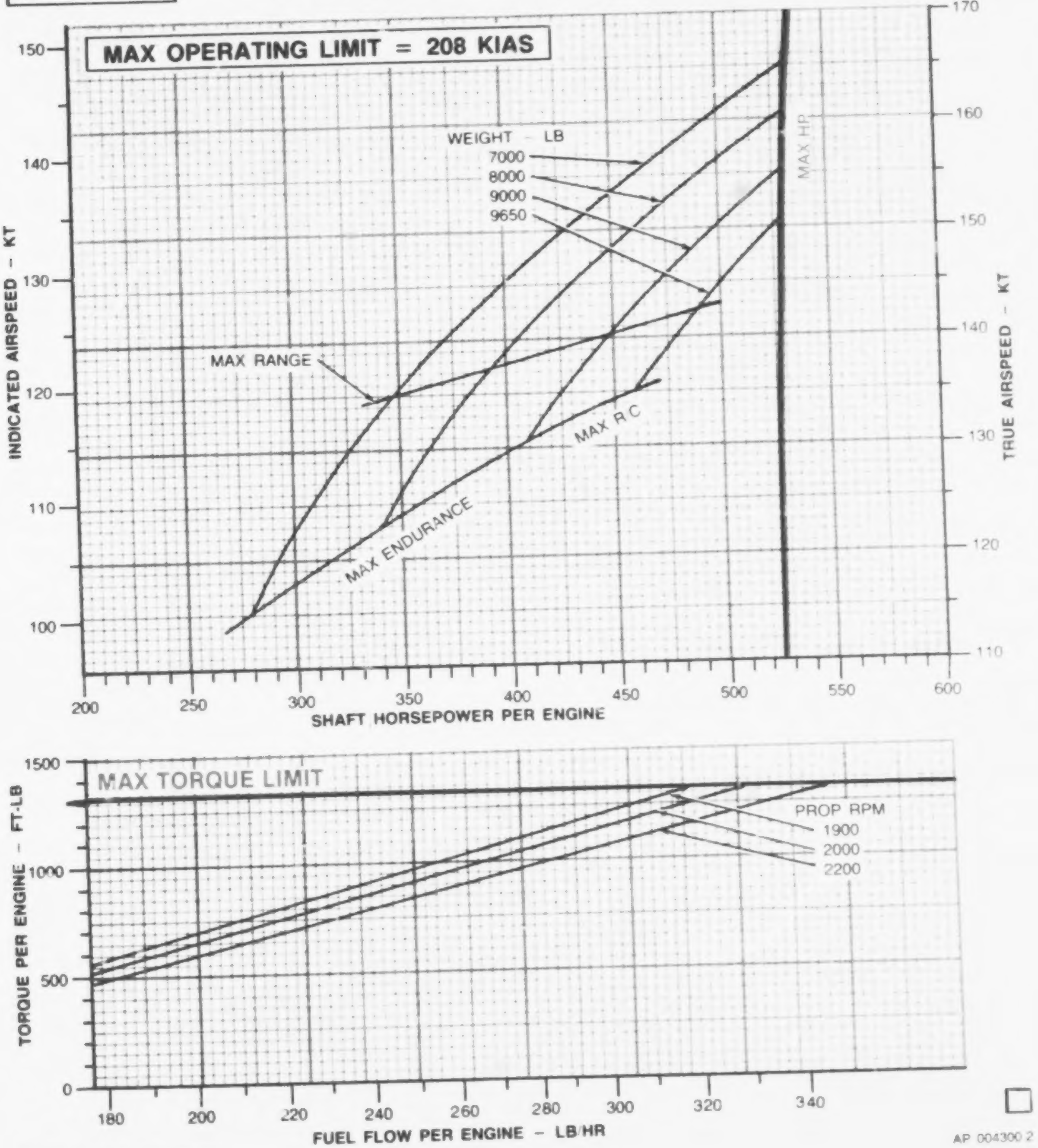
Figure 7-92. Cruise FAT −10°C, 8000 Ft **RU-21D** *(Sheet 1 of 2)*

CRUISE

CRUISE
RU-21D
T74-CP-700

SINGLE ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



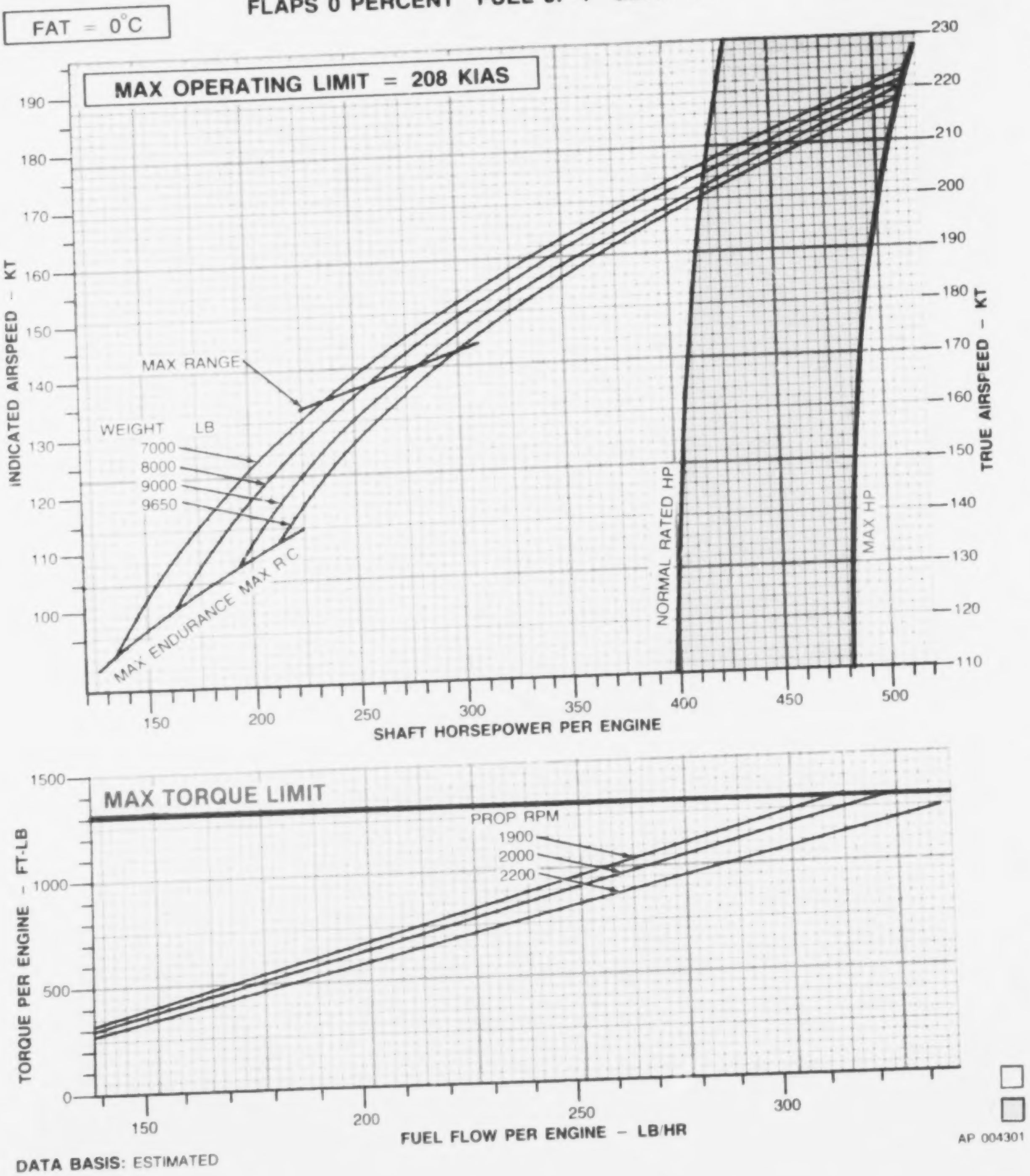
DATA BASIS: ESTIMATED

Figure 7-92. Cruise FAT −10°C, 8000 Ft **RU-21D** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700



DATA BASIS: ESTIMATED

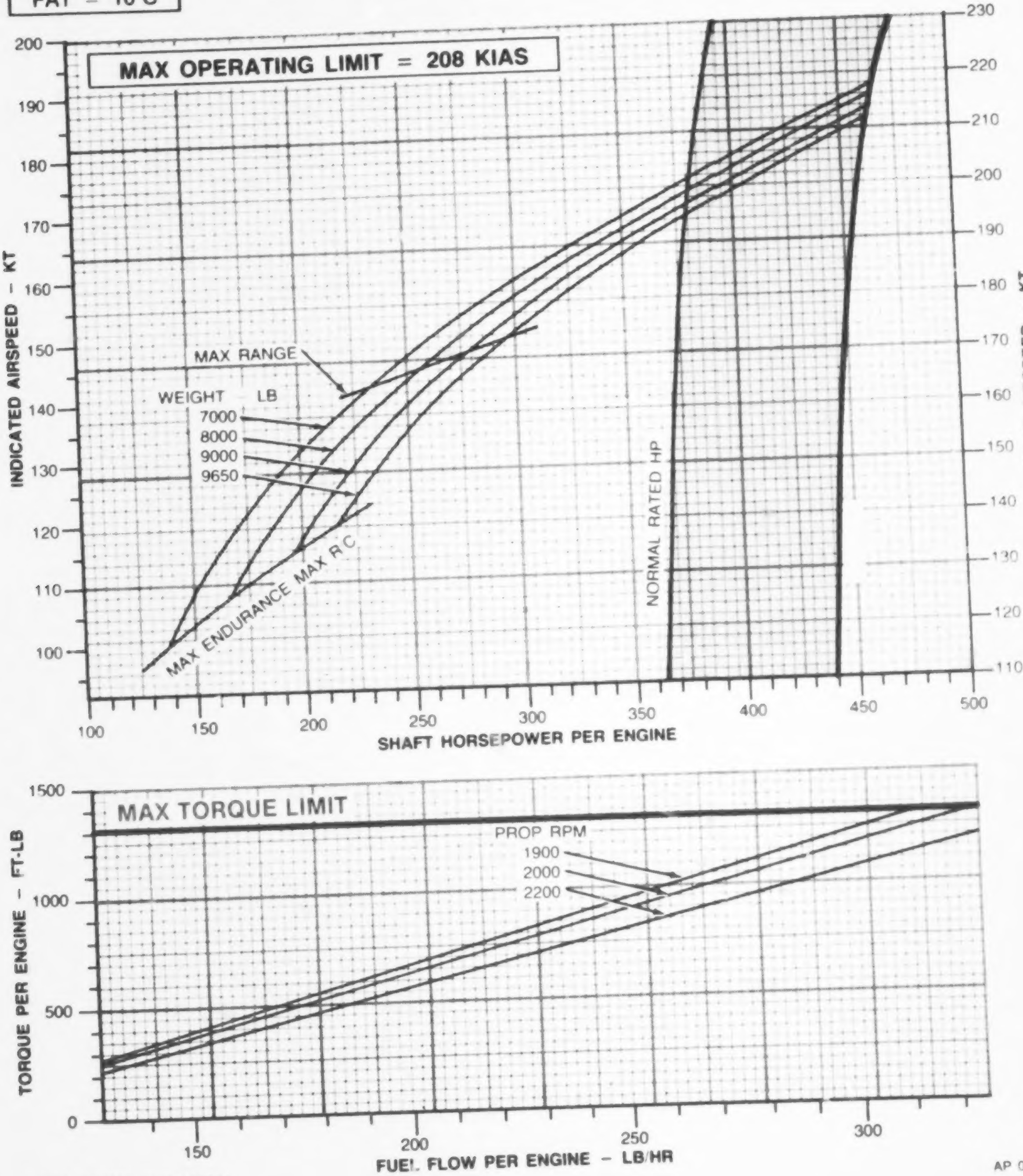
Figure 7-93. Cruise FAT 0°C, 8000 Ft **RU-21D**

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 10°C



DATA BASIS: ESTIMATED

AP 004302

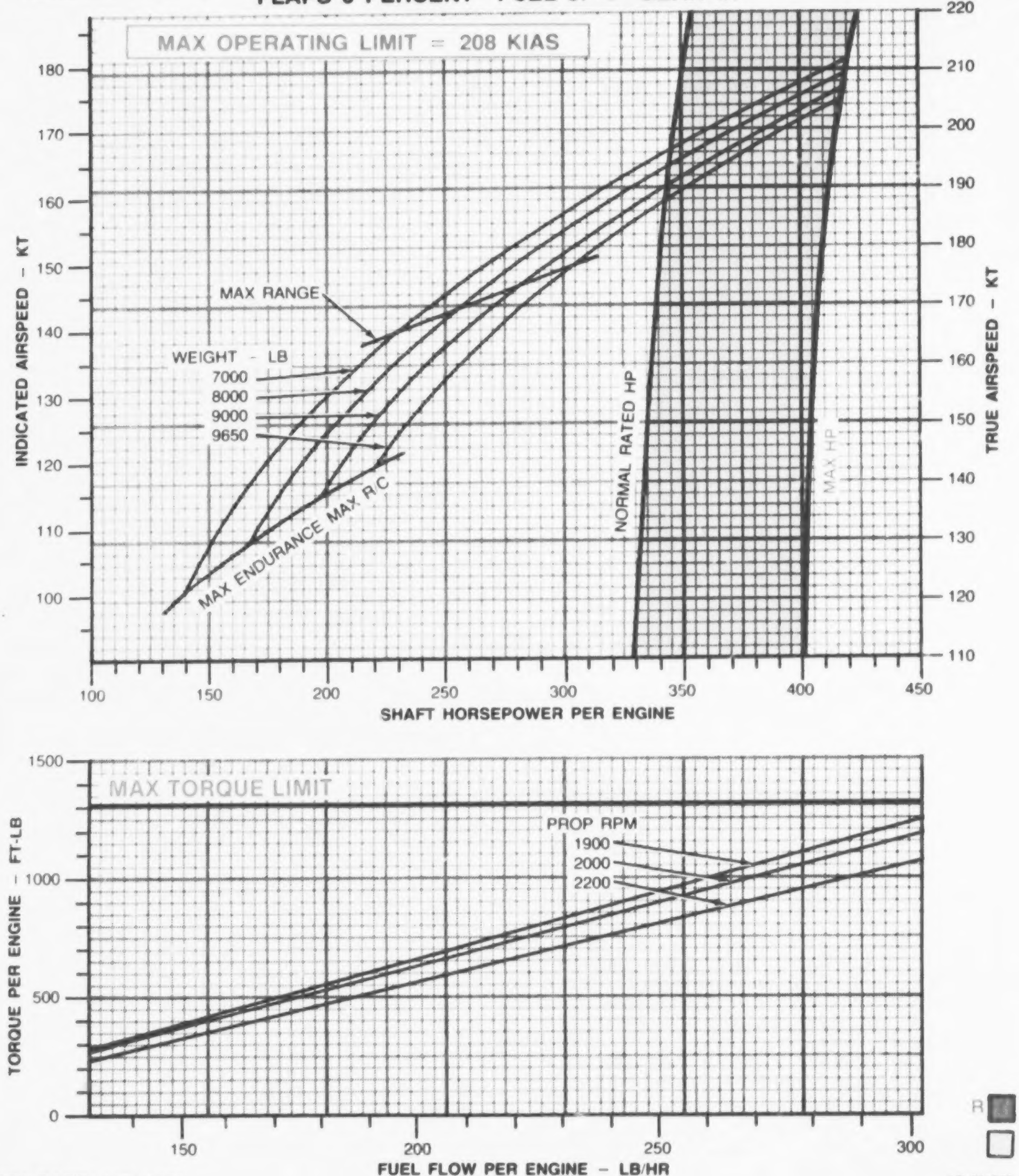
Figure 7-94. Cruise FAT 10°C, 8000 Ft **RU-21D**

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C

CRUISE
RU-21D
T74-CP-700



DATA BASIS: ESTIMATED

AP 004303

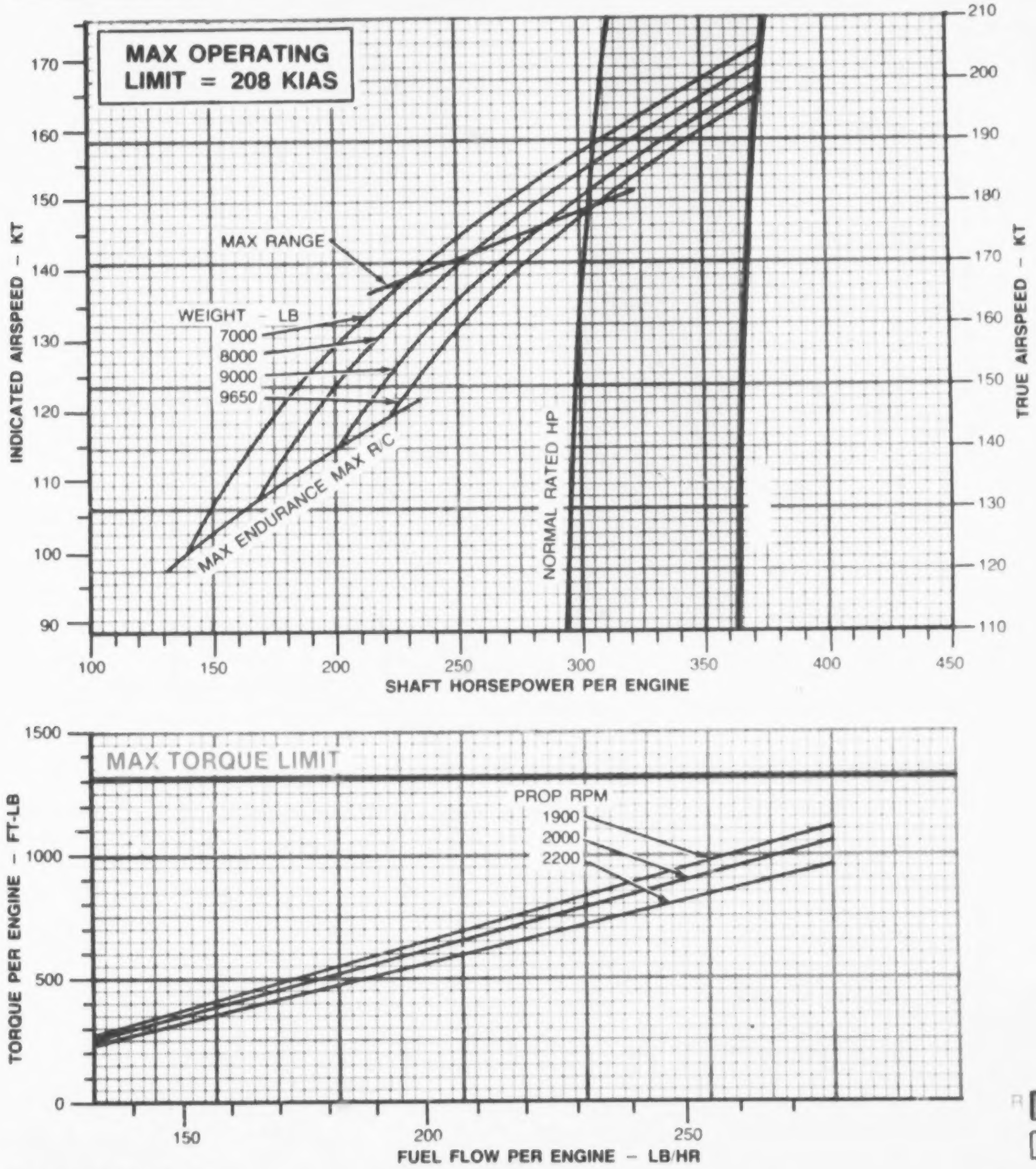
Figure 7-95. Cruise FAT 20°C, 8000 Ft **RU-21D**

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 8000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 30°C



DATA BASIS: ESTIMATED

AP 004304

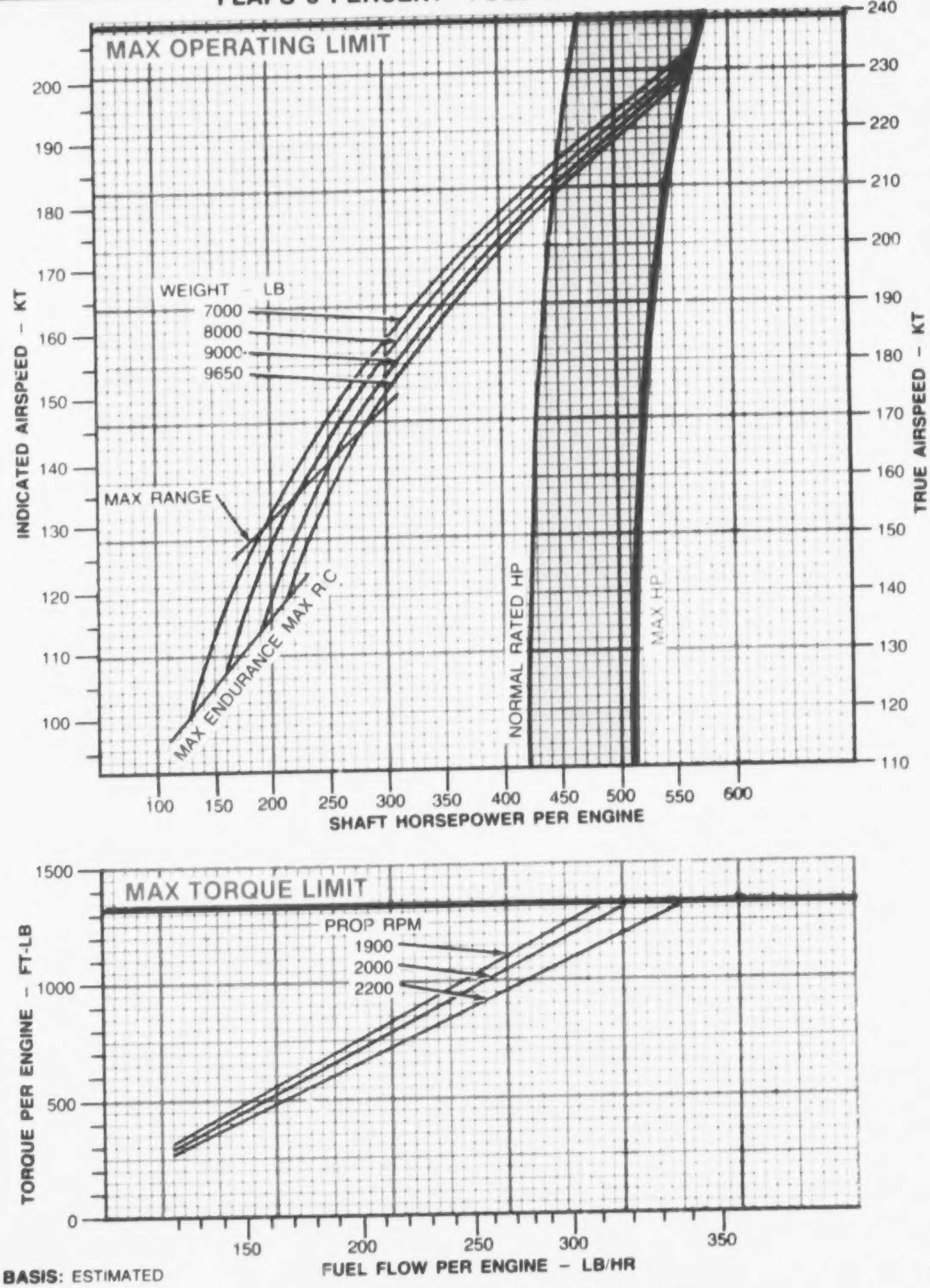
Figure 7-96. Cruise FAT 30°C, 8000 Ft **RU-21D**

CRUISE
RU-21D
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



DATA BASIS: ESTIMATED

AP 004305 1

Figure 7-97. Cruise FAT −30°C, 12,000 Ft RU 21D *(Sheet 1 of 2)*

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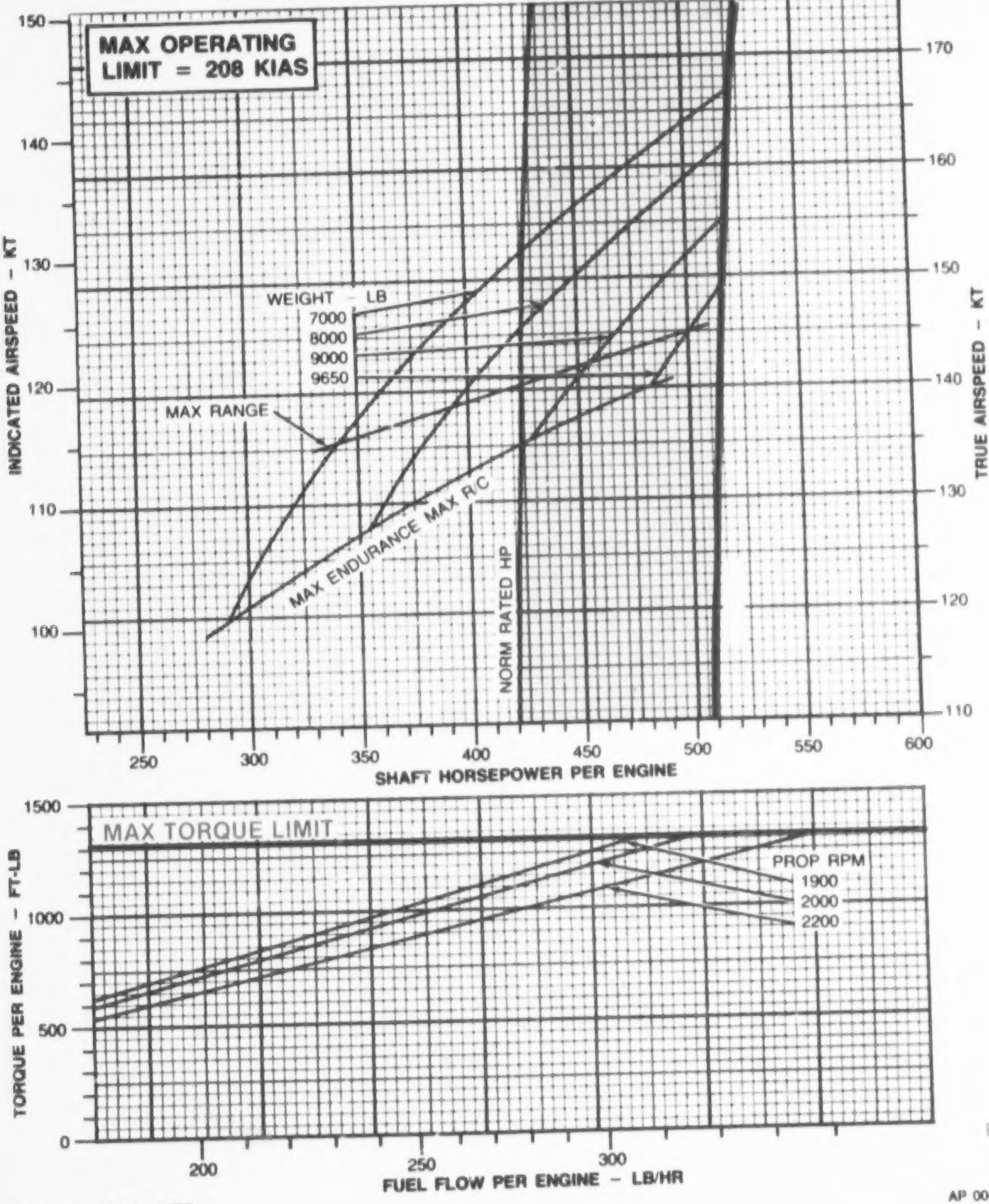
FAT = −30°C

CRUISE

SINGLE ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700



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AP 004305 2

DATA BASIS: ESTIMATED

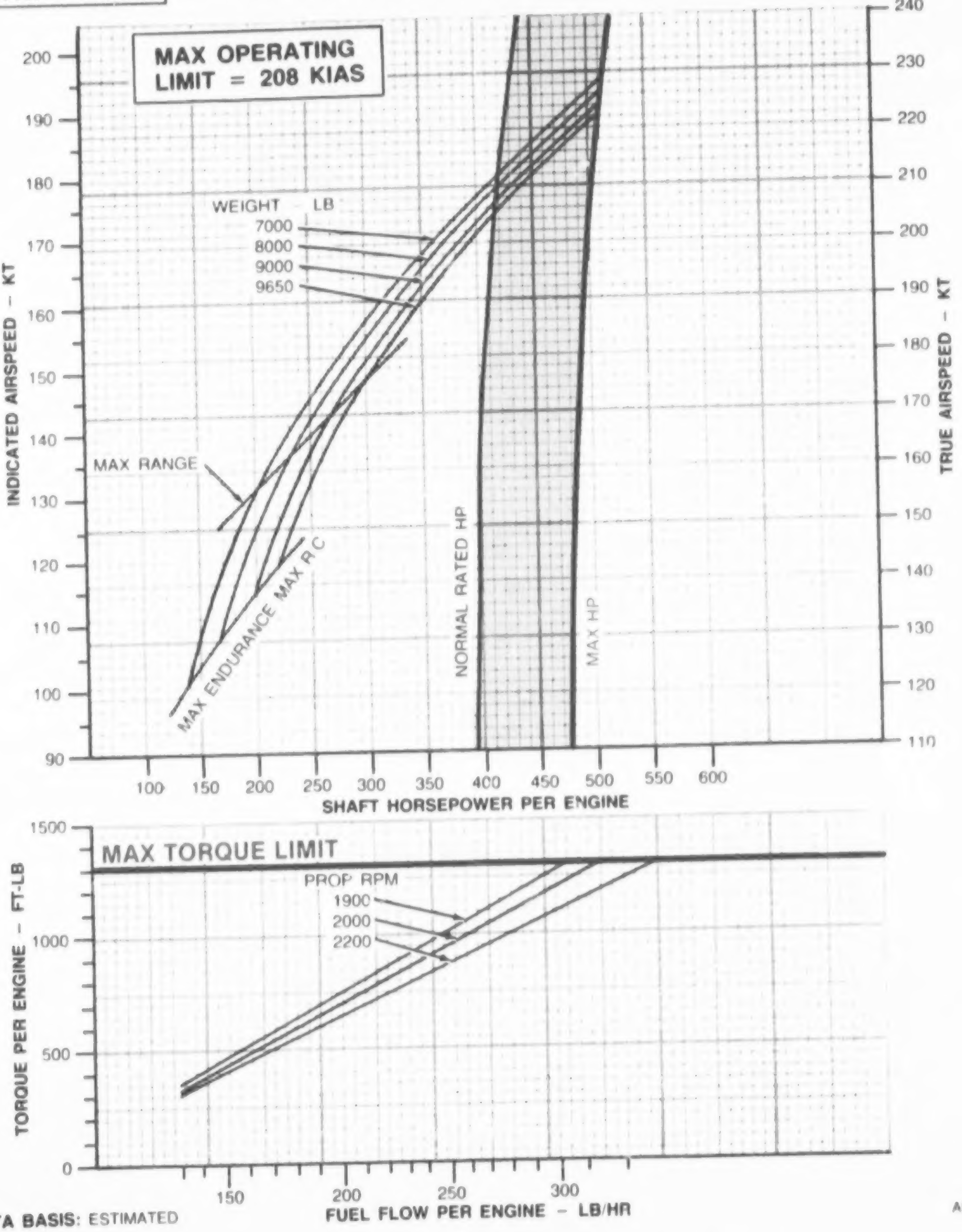
Figure 7-97. Cruise FAT −30°C, 12,000 Ft **RU-21D** *(Sheet 2 of 2)*

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = −20°C



DATA BASIS: ESTIMATED

AF 004306

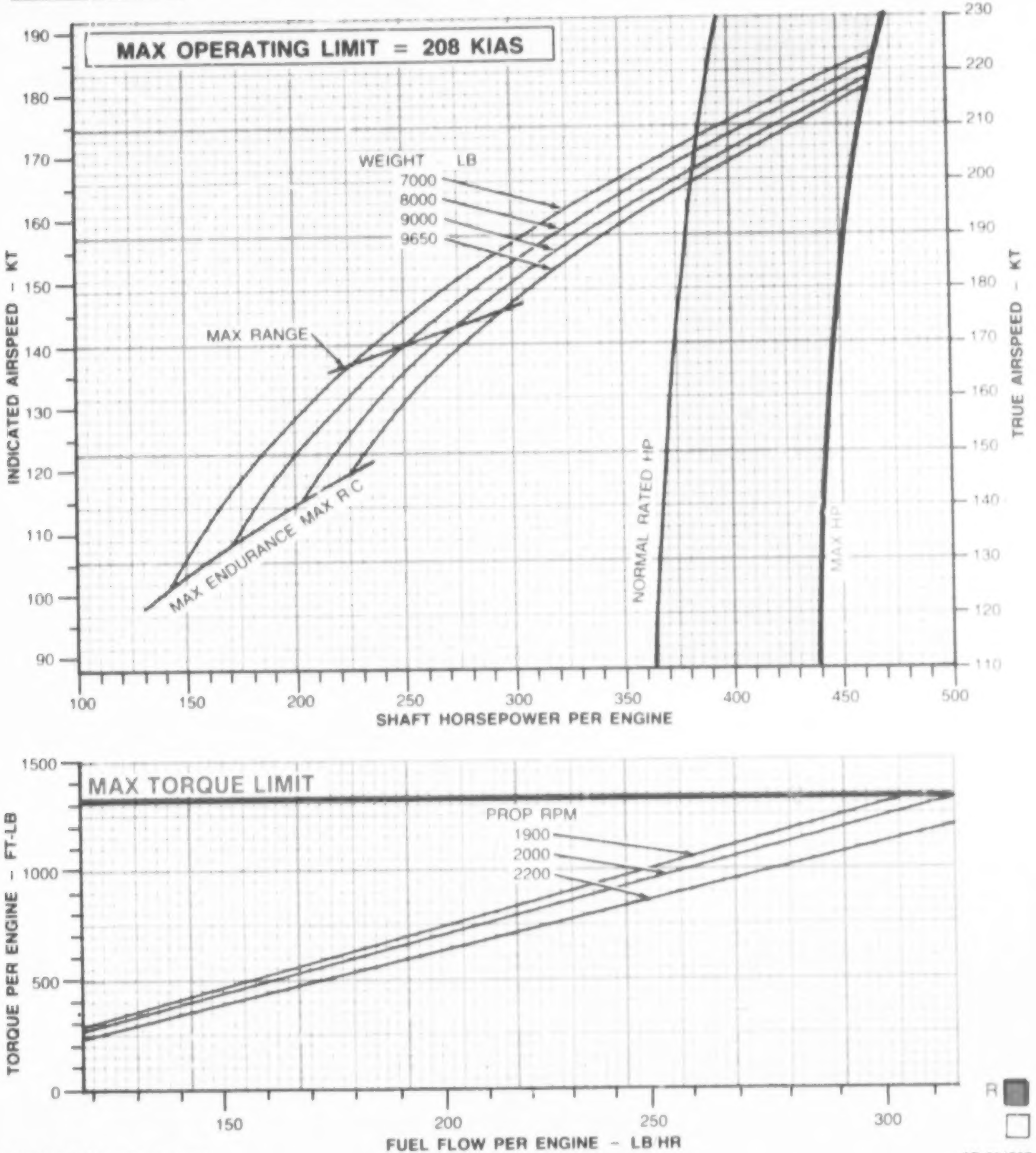
Figure 7-98. Cruise FAT −20°C, 12,000 Ft **RU-21D**

CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



DATA BASIS: ESTIMATED

AP 004307

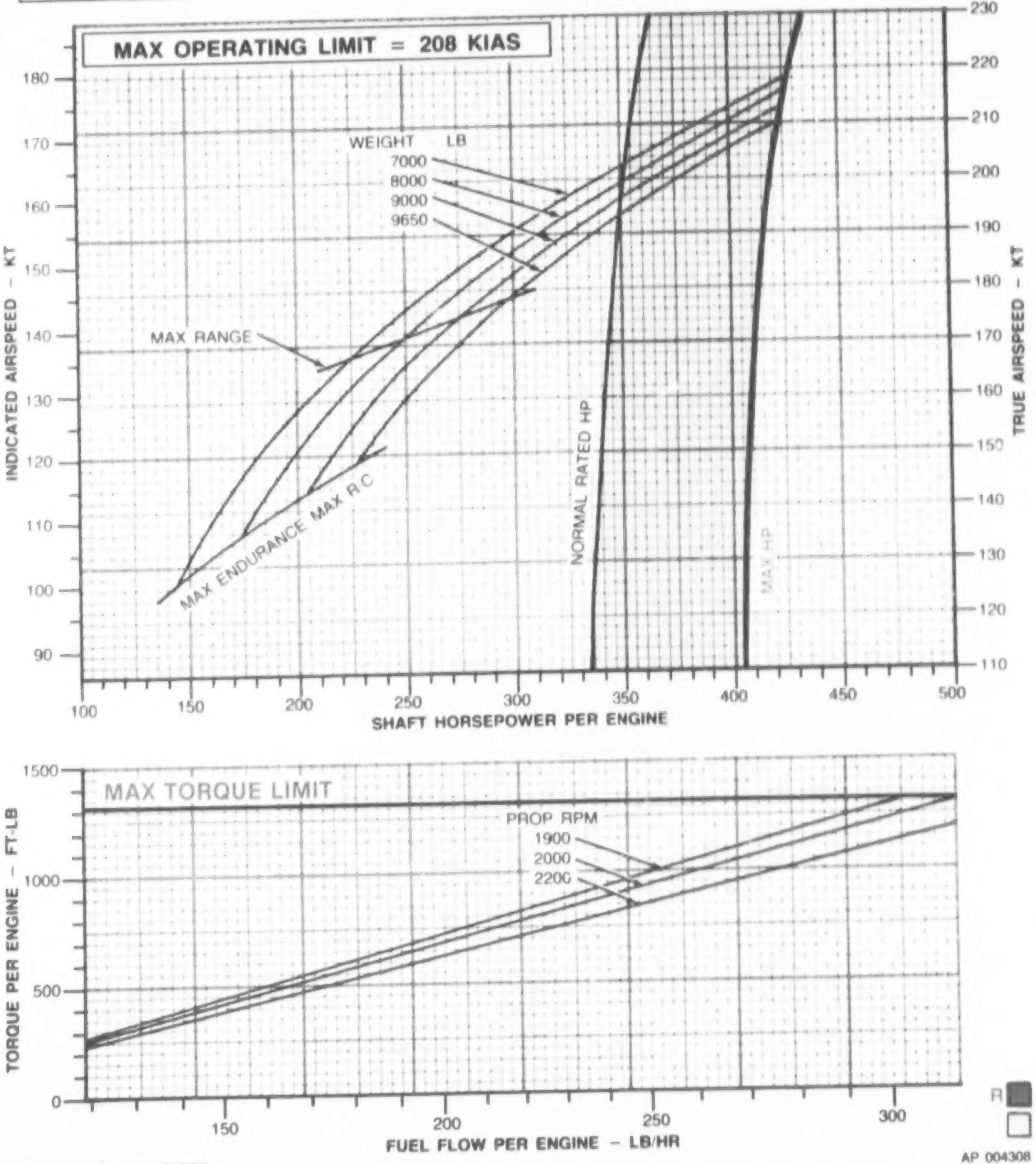
Figure 7-99. Cruise FAT −10°C, 12,000 Ft **RU-21D**

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 0°C



AP 004308

DATA BASIS: ESTIMATED

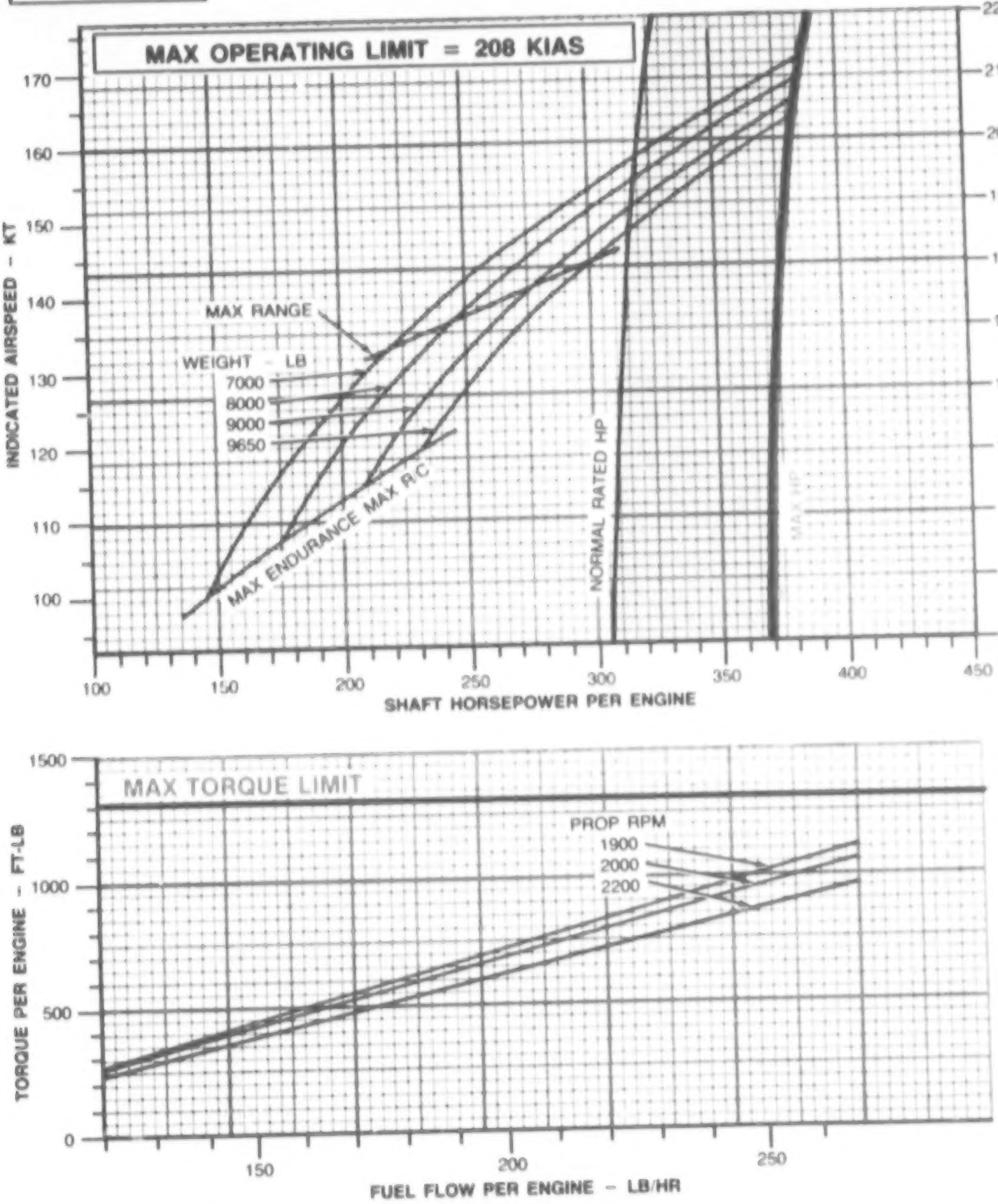
Figure 7-100. Cruise FAT 0°C, 12,000 Ft RU-21D

CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 10°C



AP 004301

DATA BASIS: ESTIMATED

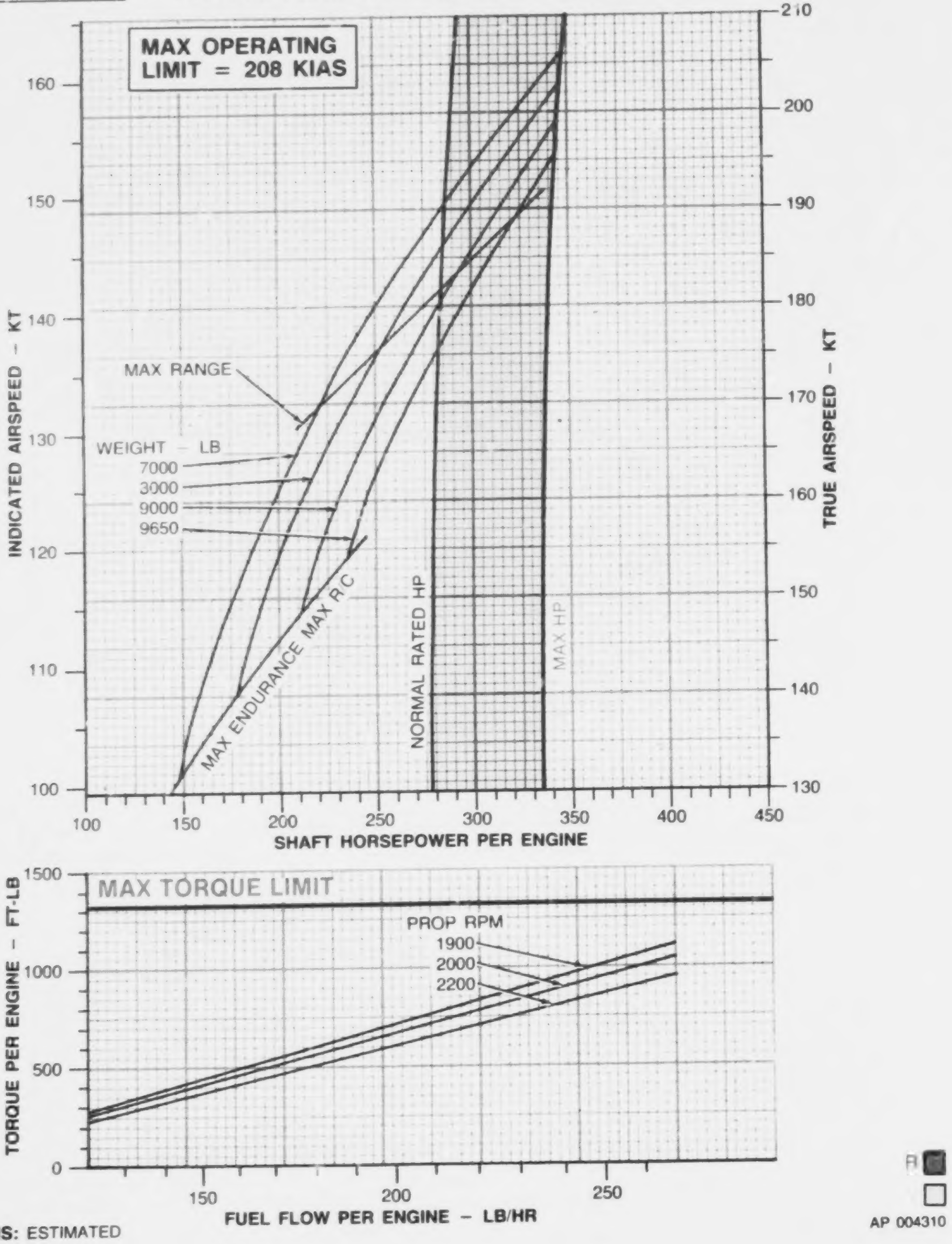
Figure 7-101. Cruise FAT 10°C, 12,000 Ft RU-21D

CRUISE
RU-21D
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 12,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 20°C



DATA BASIS: ESTIMATED

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AP 004310

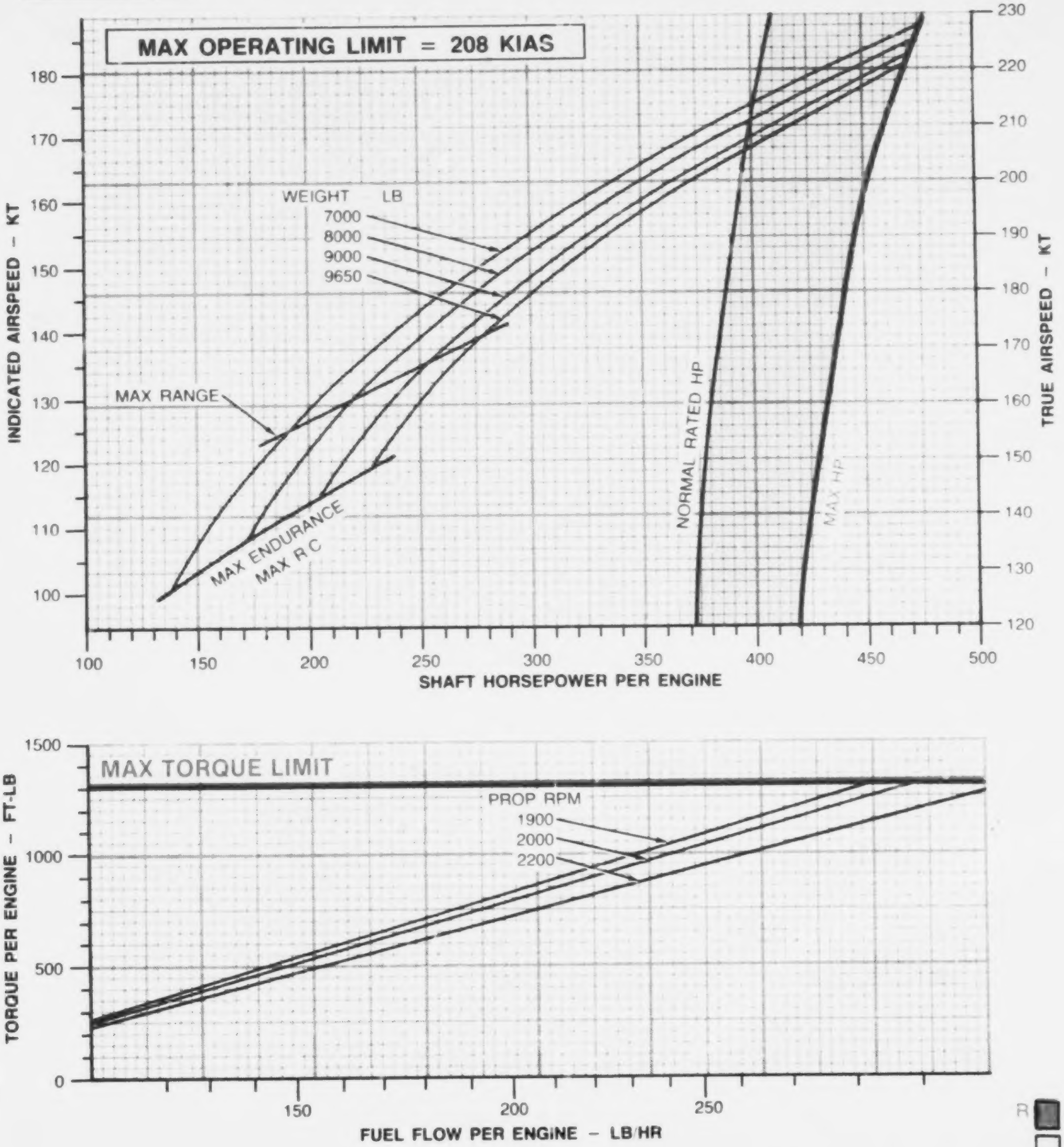
Figure 7-102. Cruise FAT 20°C, 12,000 Ft **RU-21D**

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = −40°C



DATA BASIS: ESTIMATED

AP 004311

Figure 7-103. Cruise FAT −40°C, 16,000 Ft **RU-21D**

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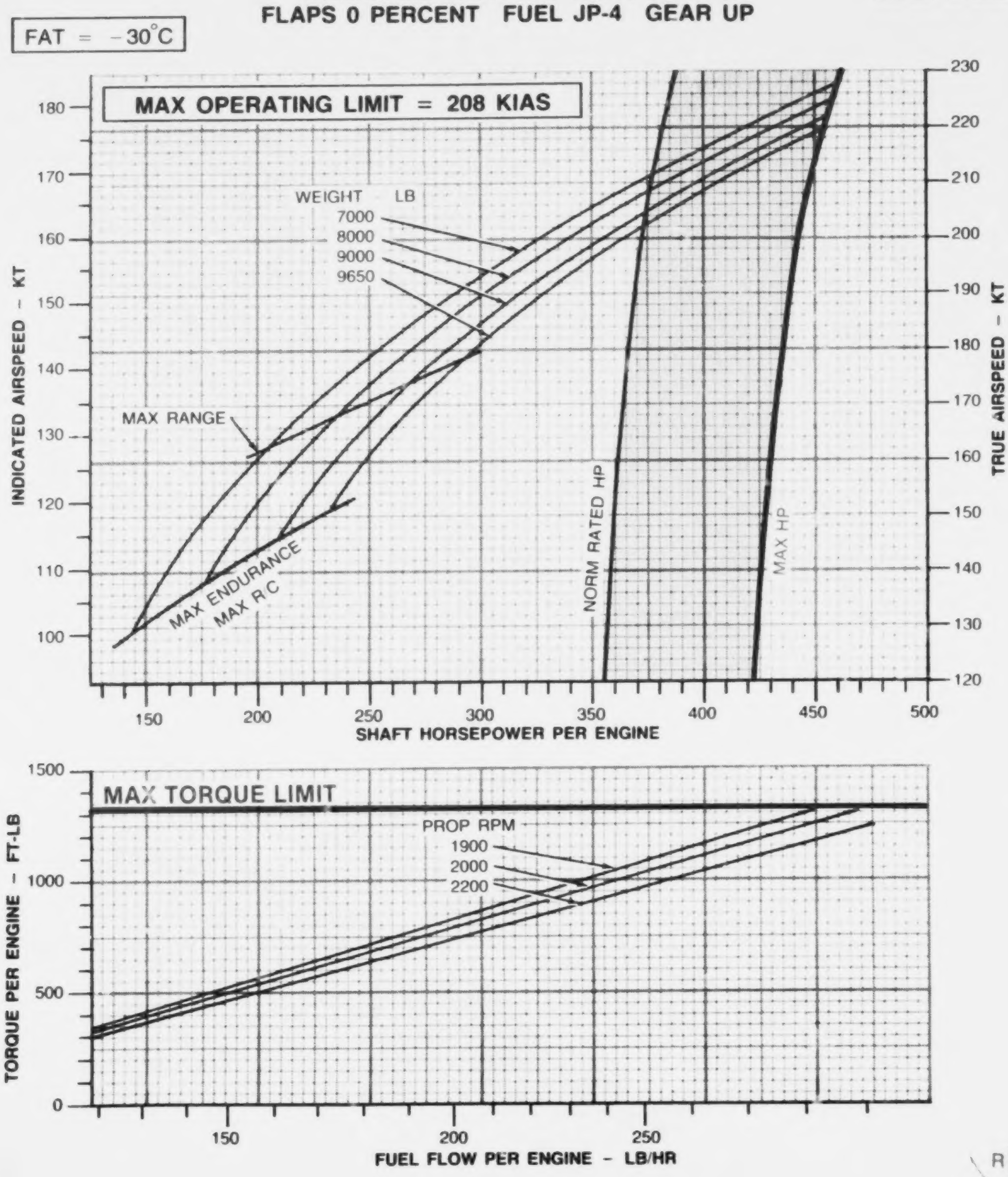
CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700



DATA BASIS: ESTIMATED

AP 004312

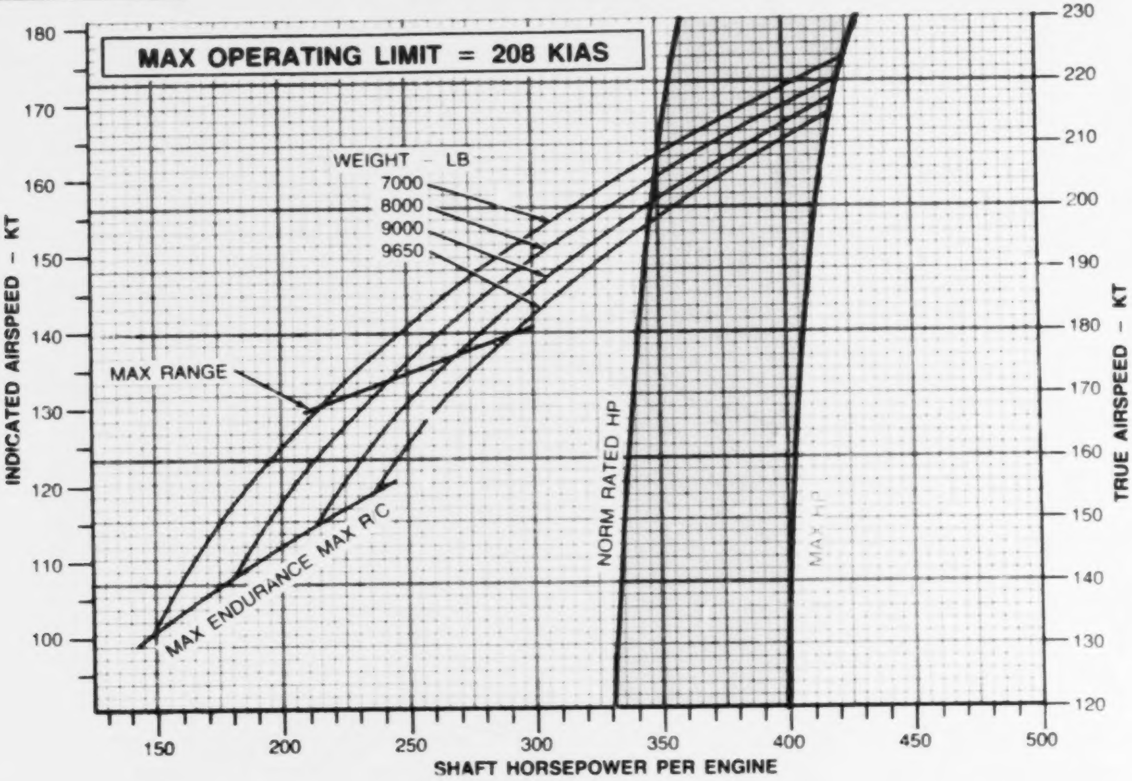
Figure 7-104. Cruise FAT −30°C, 16,000 Ft RU-21D

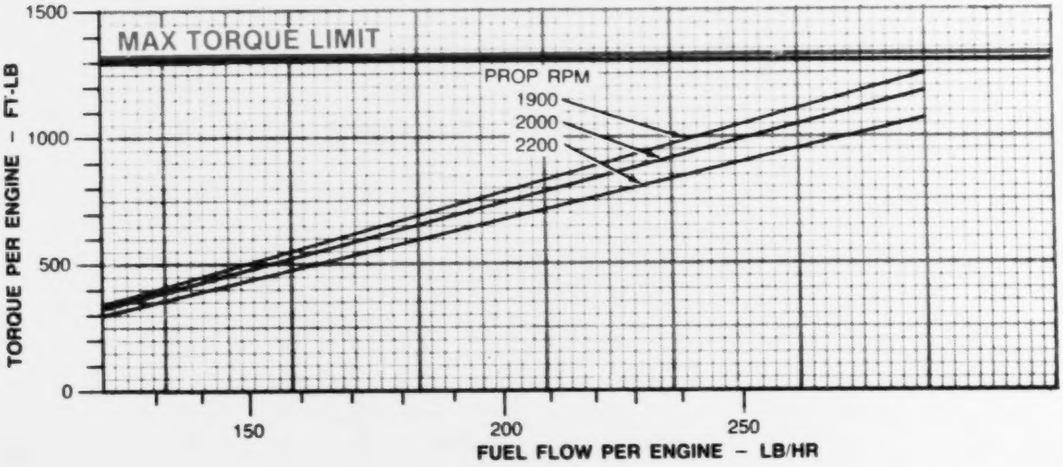
CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = −20°C





DATA BASIS: ESTIMATED

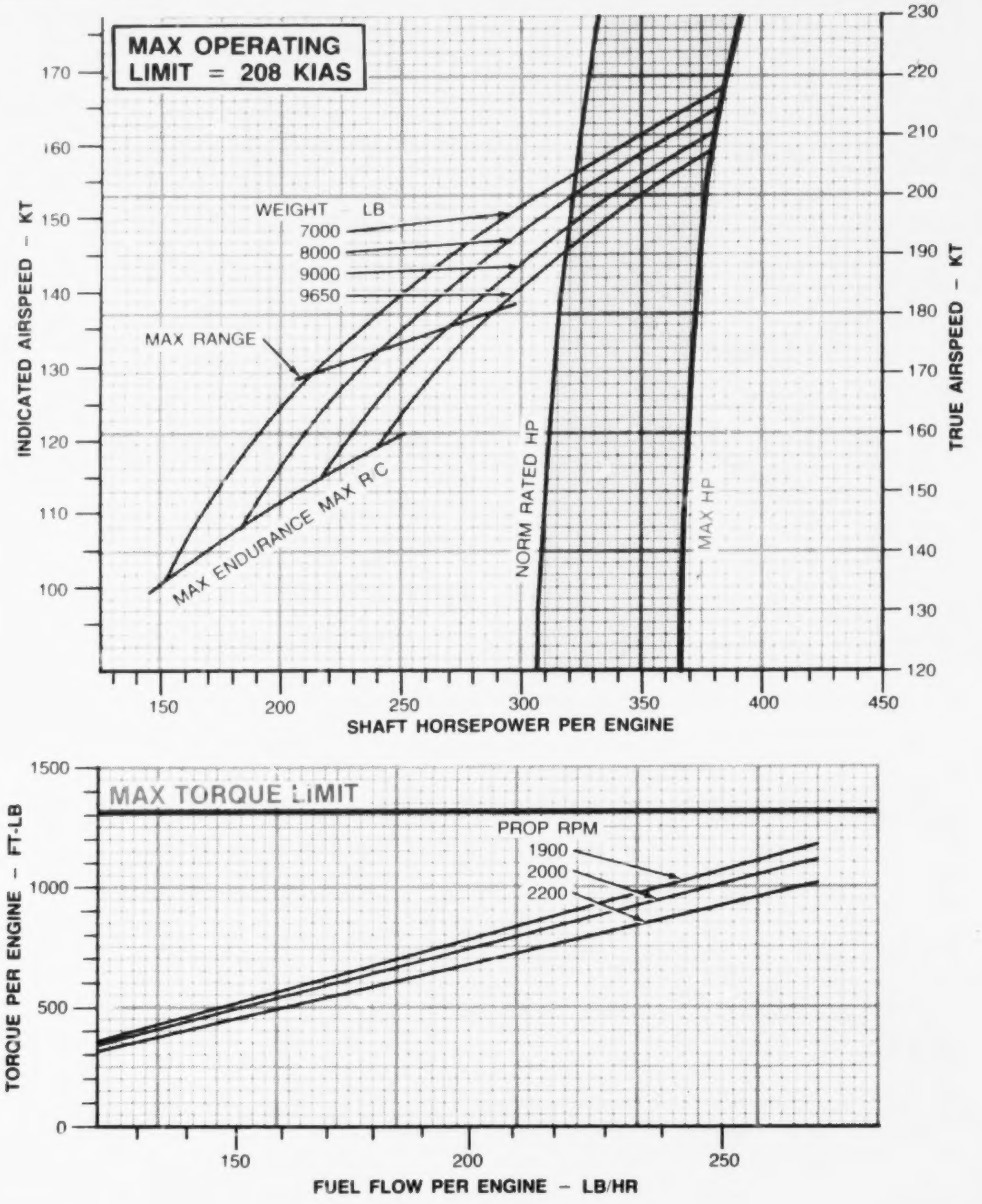
AP 004313

Figure 7-105. Cruise FAT −20°C, 16,000 Ft RU-21D

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C



DATA BASIS: ESTIMATED

AP 004314

Figure 7-106. Cruise FAT −10°C, 16,000 Ft **RU-21D**

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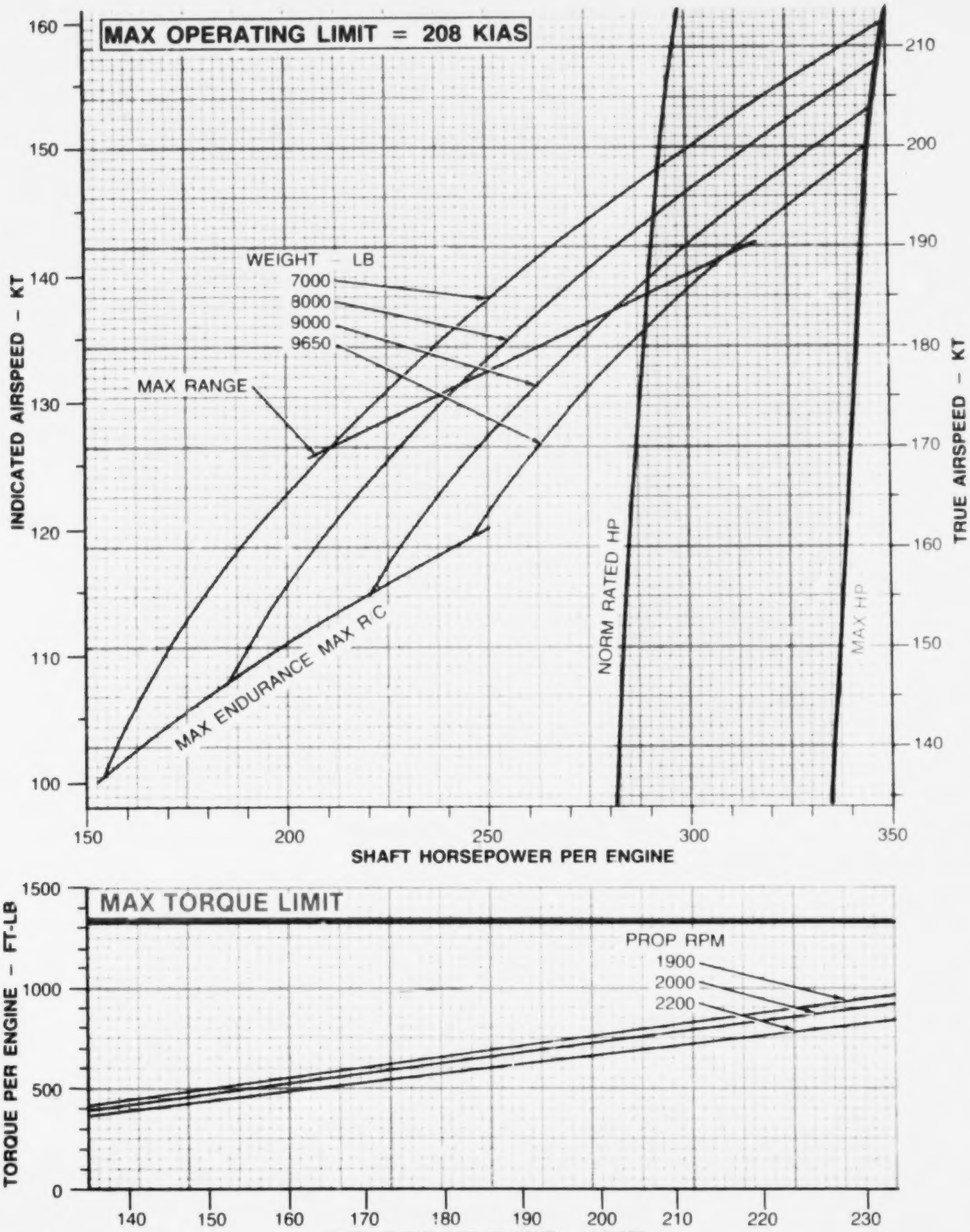
CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = 0°C

CRUISE
RU-21D
T74-CP-700



DATA BASIS: ESTIMATED

R ■
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AP 004315

Figure 7-107. Cruise FAT 0°C, 16,000 Ft **RU-21D**

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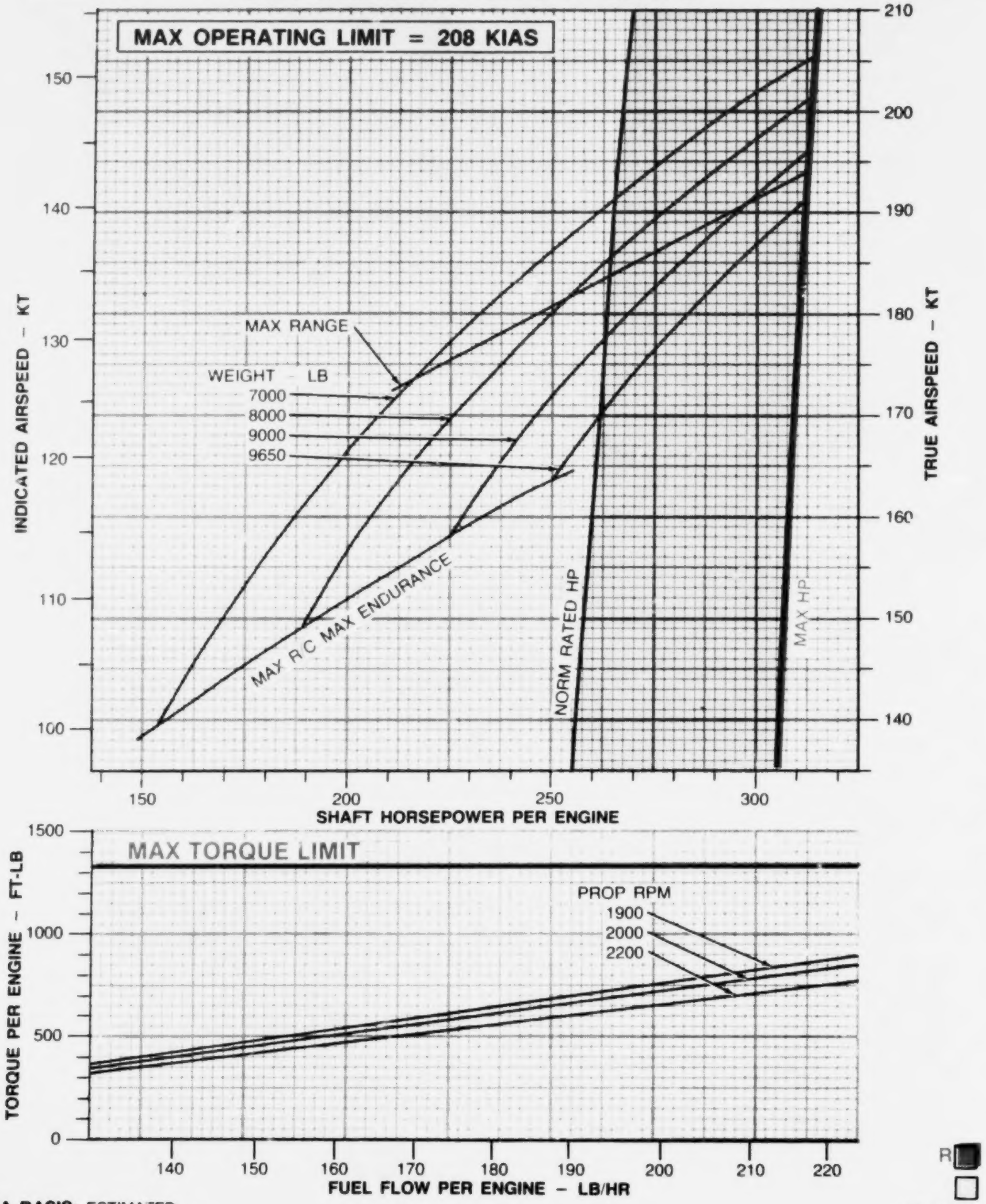
FAT = 10°C

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 16,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700



DATA BASIS: ESTIMATED

R■
☐

AP 004316

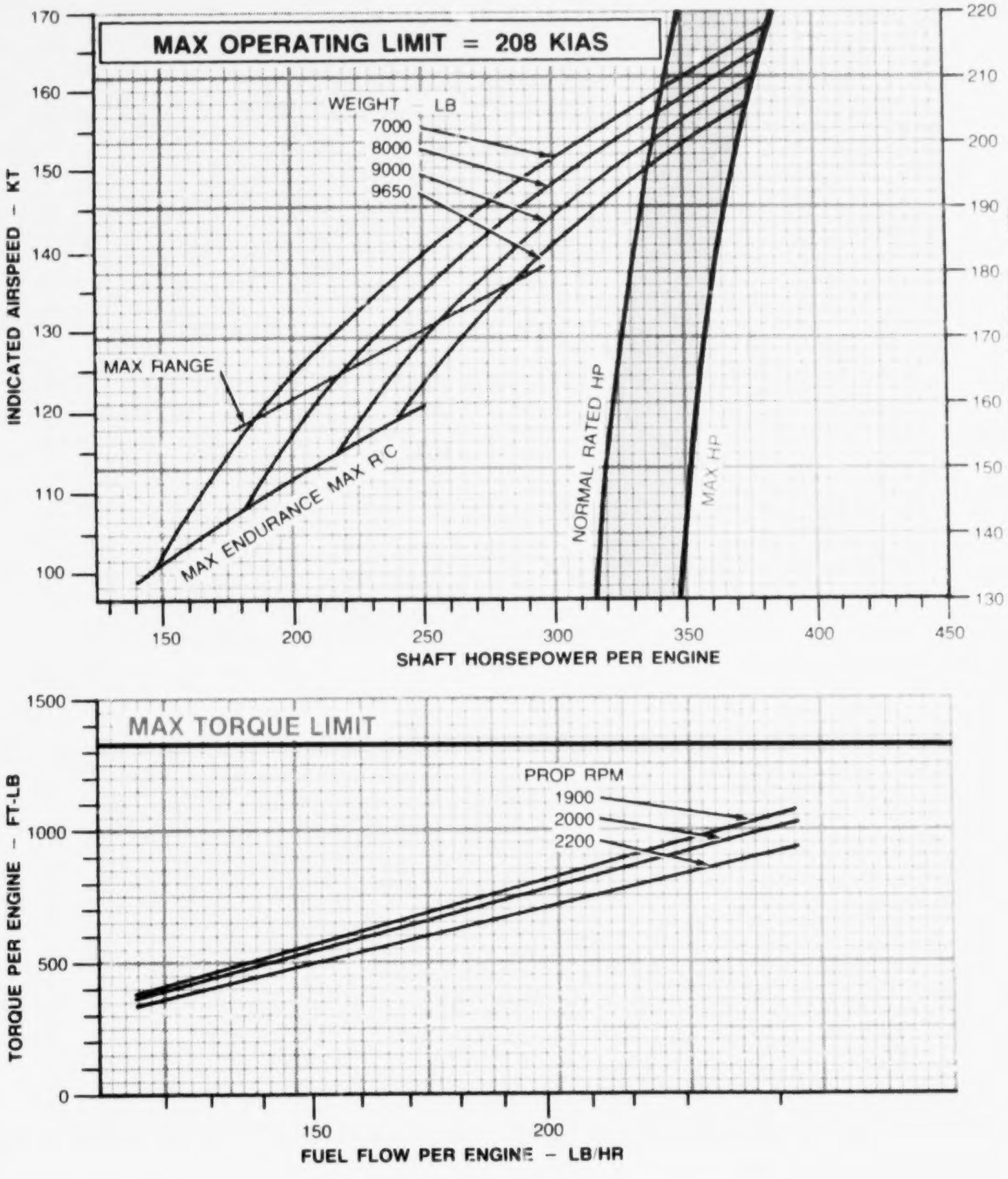
Figure 7-108. Cruise FAT 10°C, 16,000 Ft RU-21D

CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −50°C



DATA BASIS: ESTIMATED

AP 004317

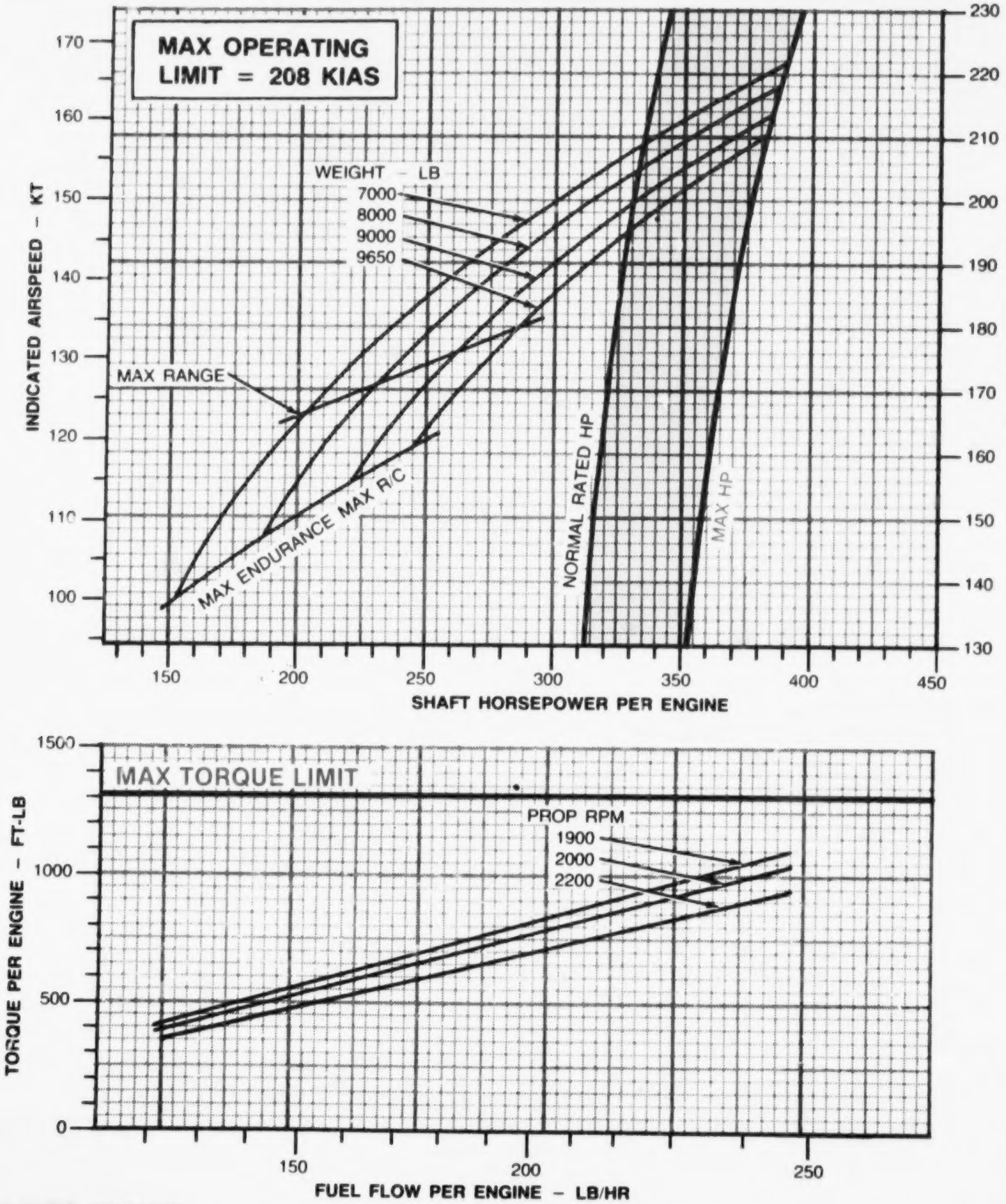
Figure 7-109. Cruise FAT −50°C, 20,000 Ft **RU-21D**

CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −40°C



DATA BASIS: ESTIMATED

R ■
☐

AP 004318

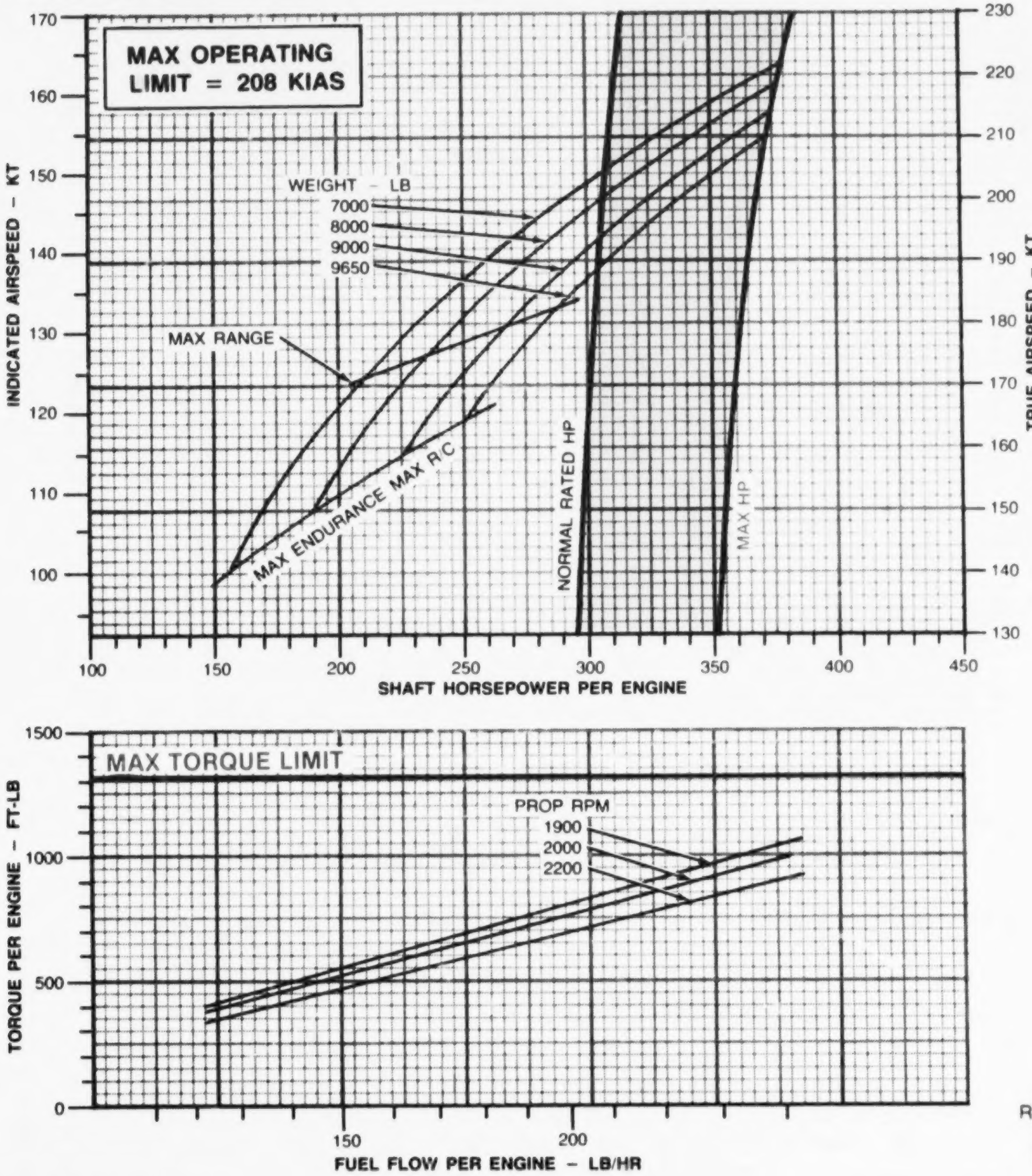
Figure 7-110. Cruise FAT −40°C, 20,000 Ft **RU-21D**

CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



DATA BASIS: ESTIMATED

AP 004319

Figure 7-111. Cruise FAT −30°C, 20,000 Ft **RU-21D**

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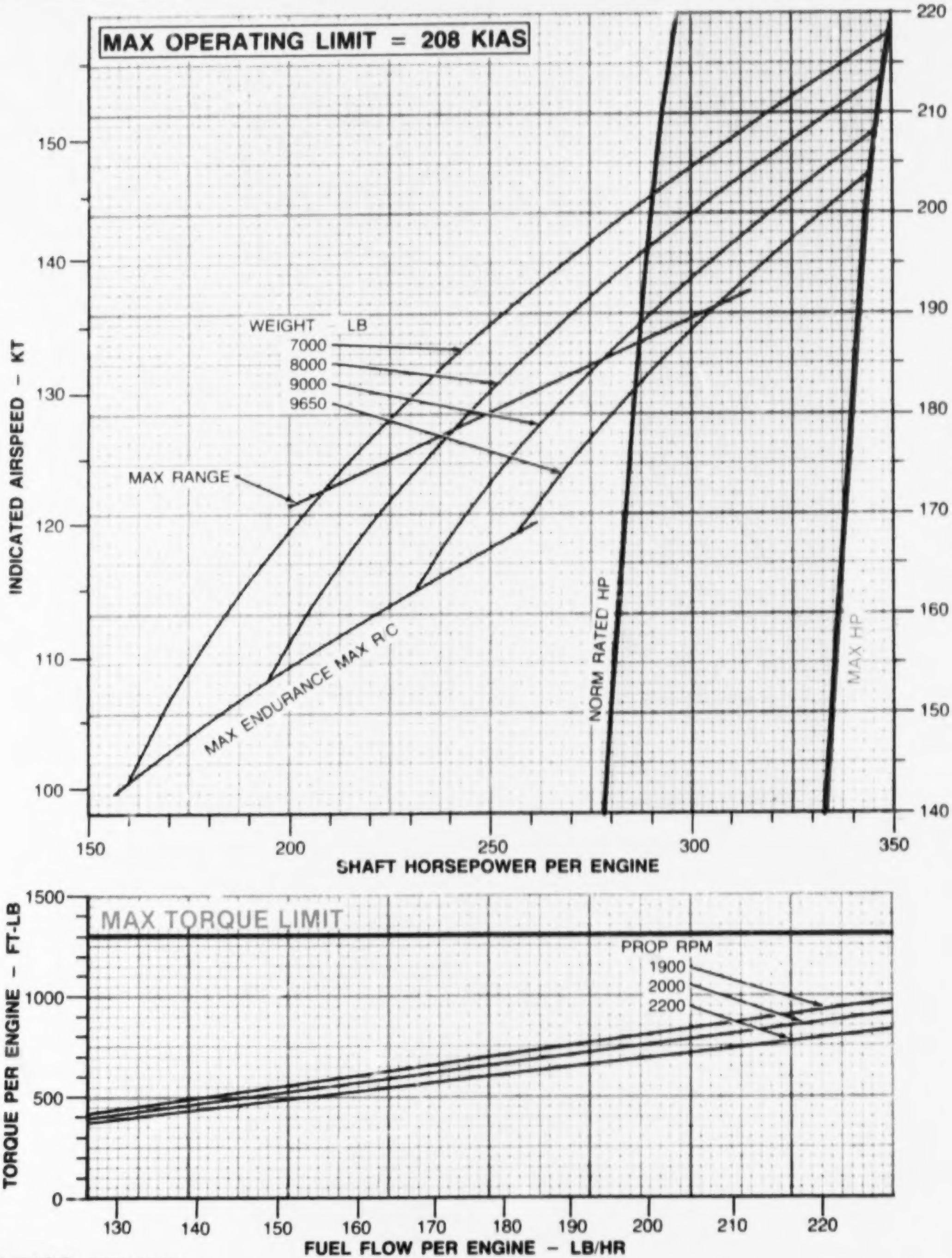
CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = −20°C



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DATA BASIS: ESTIMATED

AP 004320

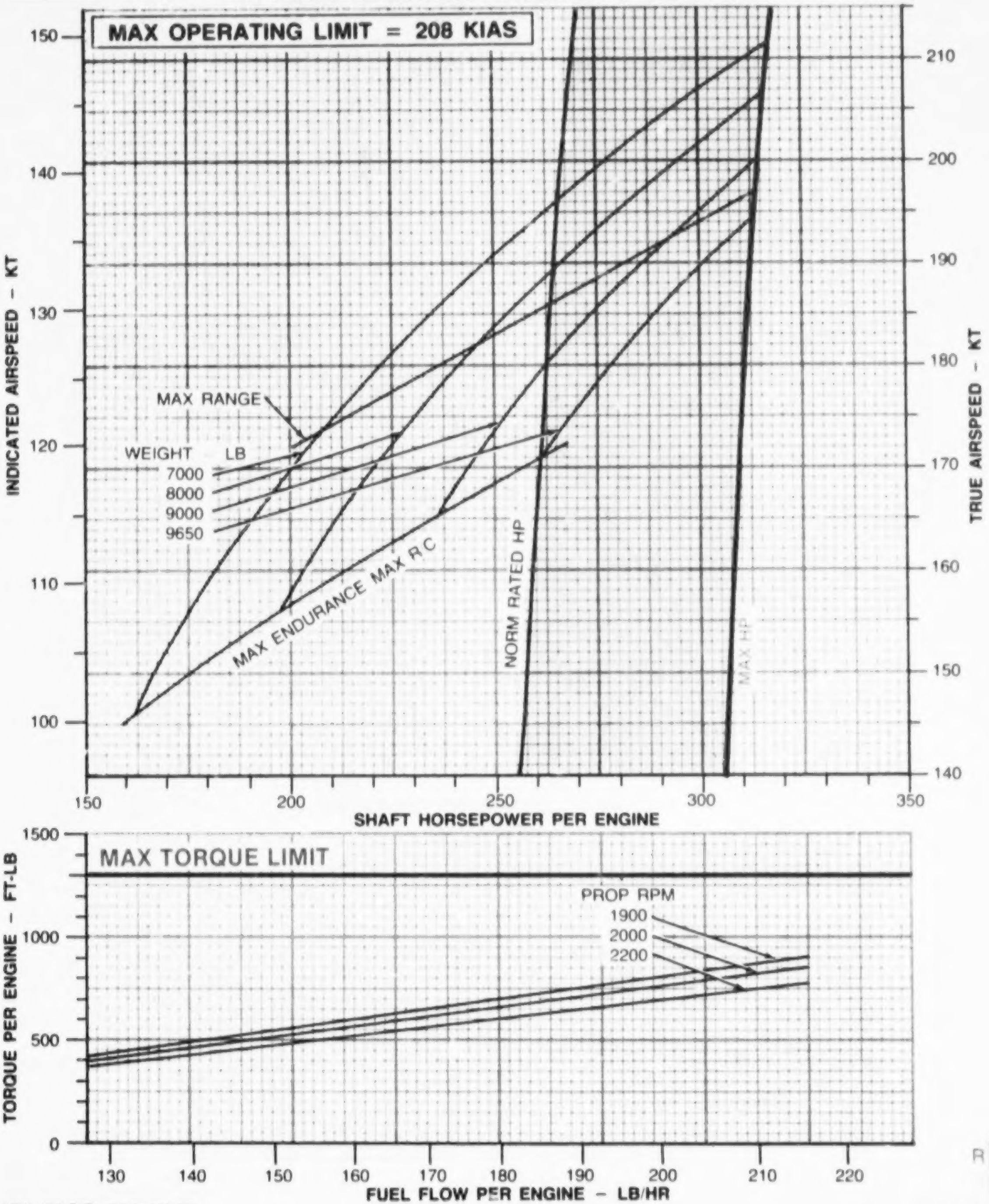
Figure 7-112. Cruise FAT −20°C, 20,000 Ft RU-21D

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −10°C

CRUISE
RU-21D
T74-CP-700



DATA BASIS: ESTIMATED

AP004321

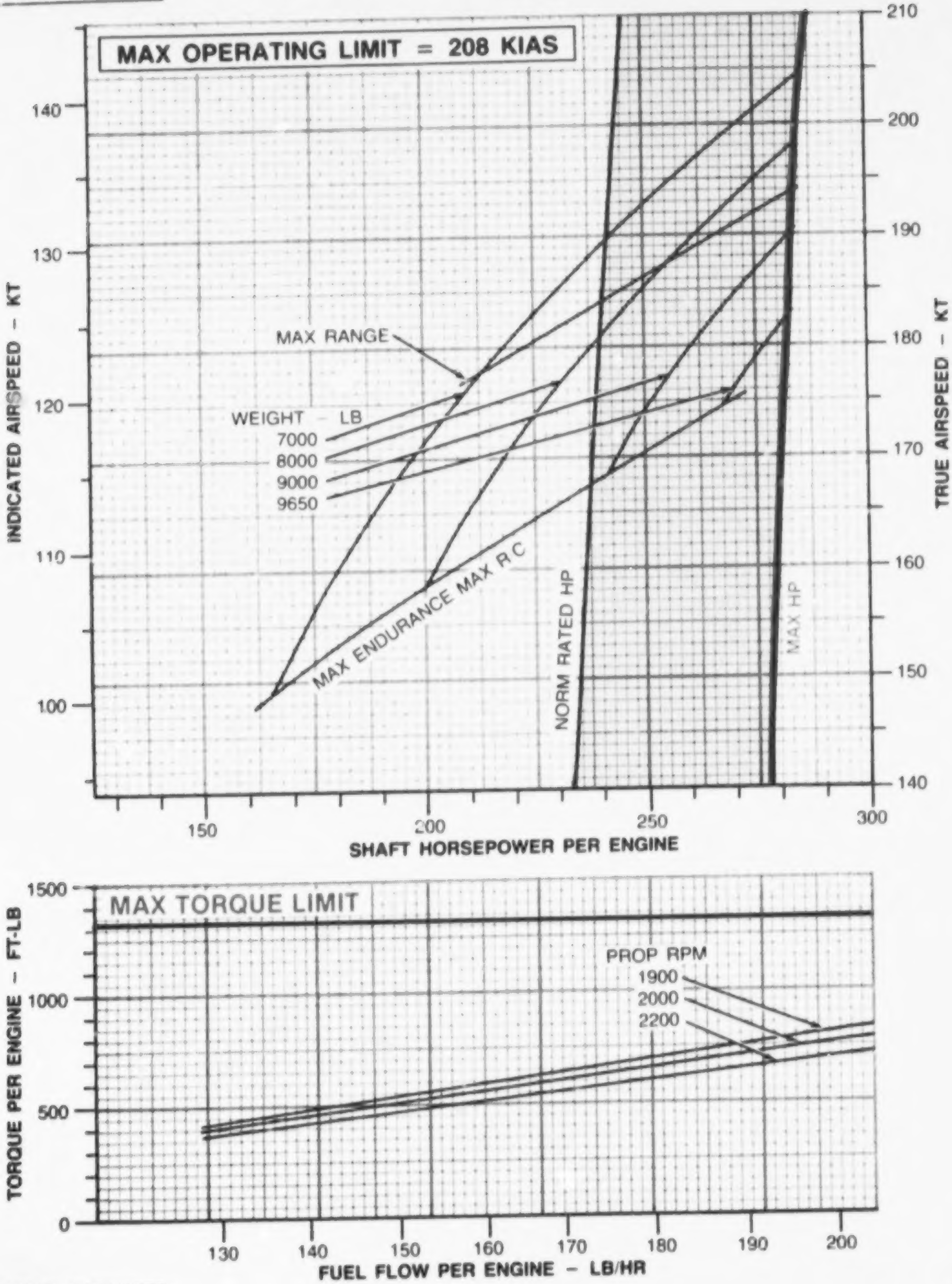
Figure 7-113. Cruise FAT −10°C, 20,000 Ft **RU-21D**

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 20,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = 0°C



DATA BASIS: ESTIMATED

AP 004322

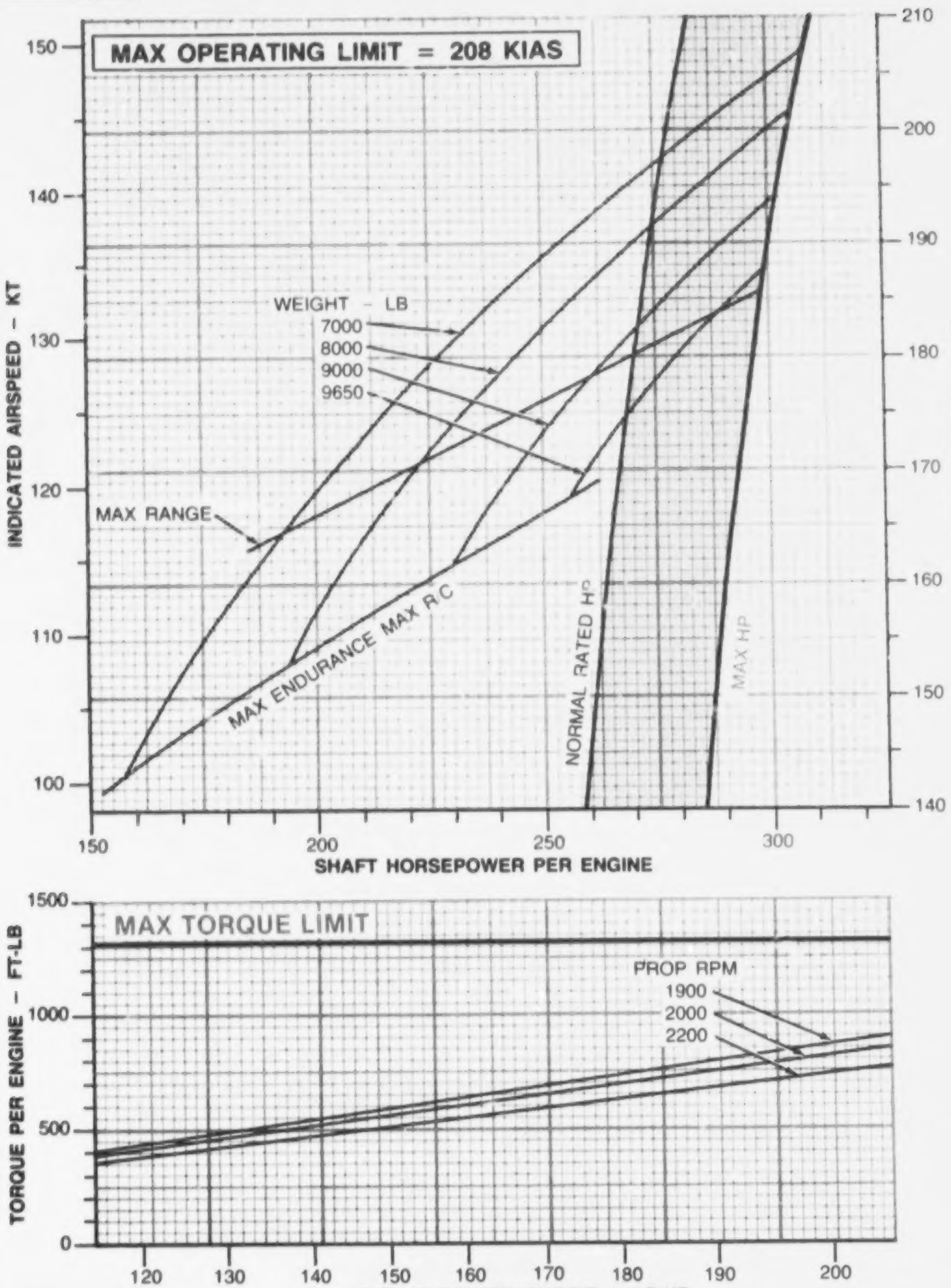
Figure 7-114. Cruise FAT 0°C, 20,000 Ft **RU-21D**

CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −60°C



DATA BASIS: ESTIMATED

R

AP 004323

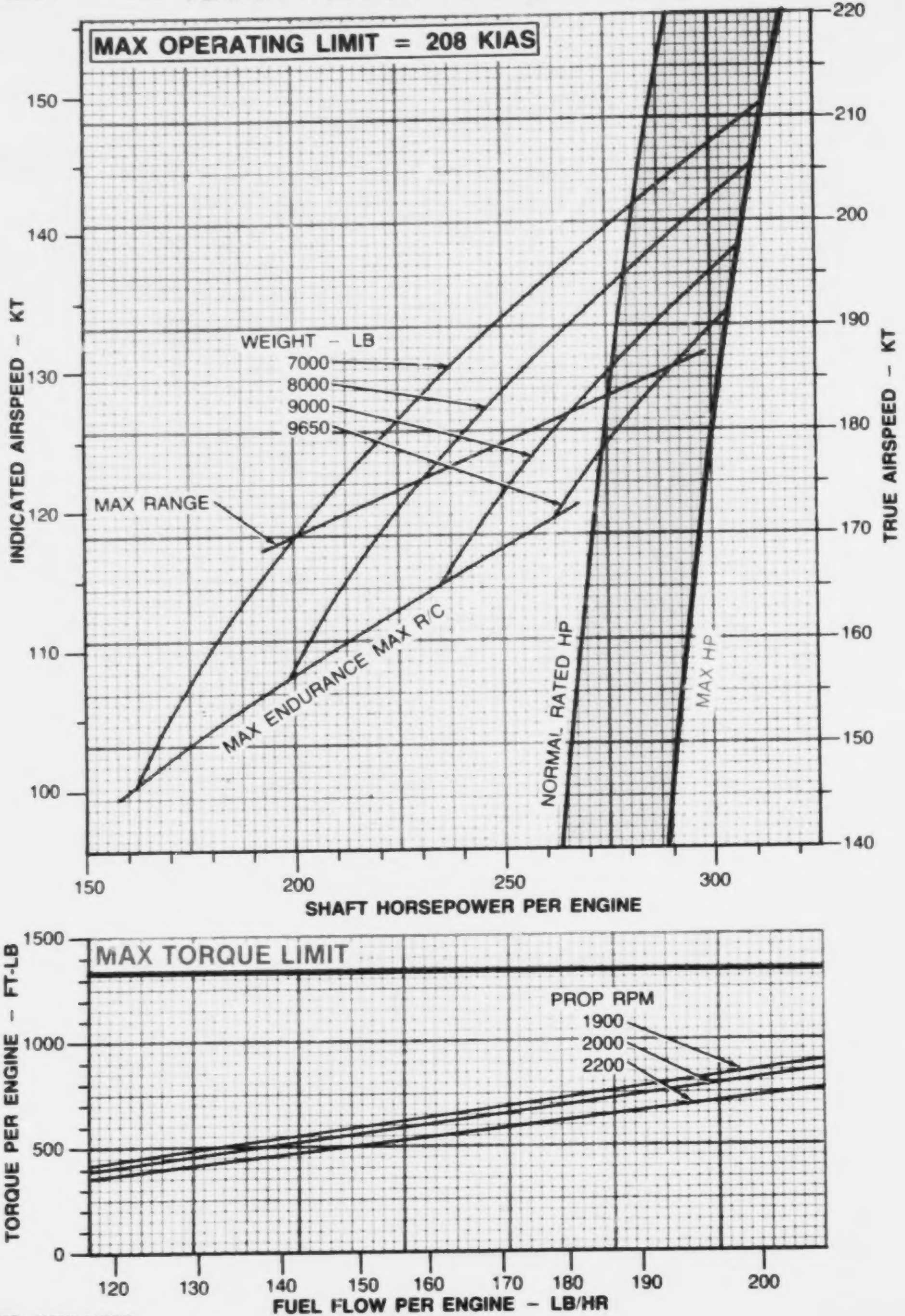
Figure 7-115. Cruise FAT −60°C, 24,000 Ft RU-21D

CRUISE
RU-21D
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −50°C



DATA BASIS: ESTIMATED

AP 004324

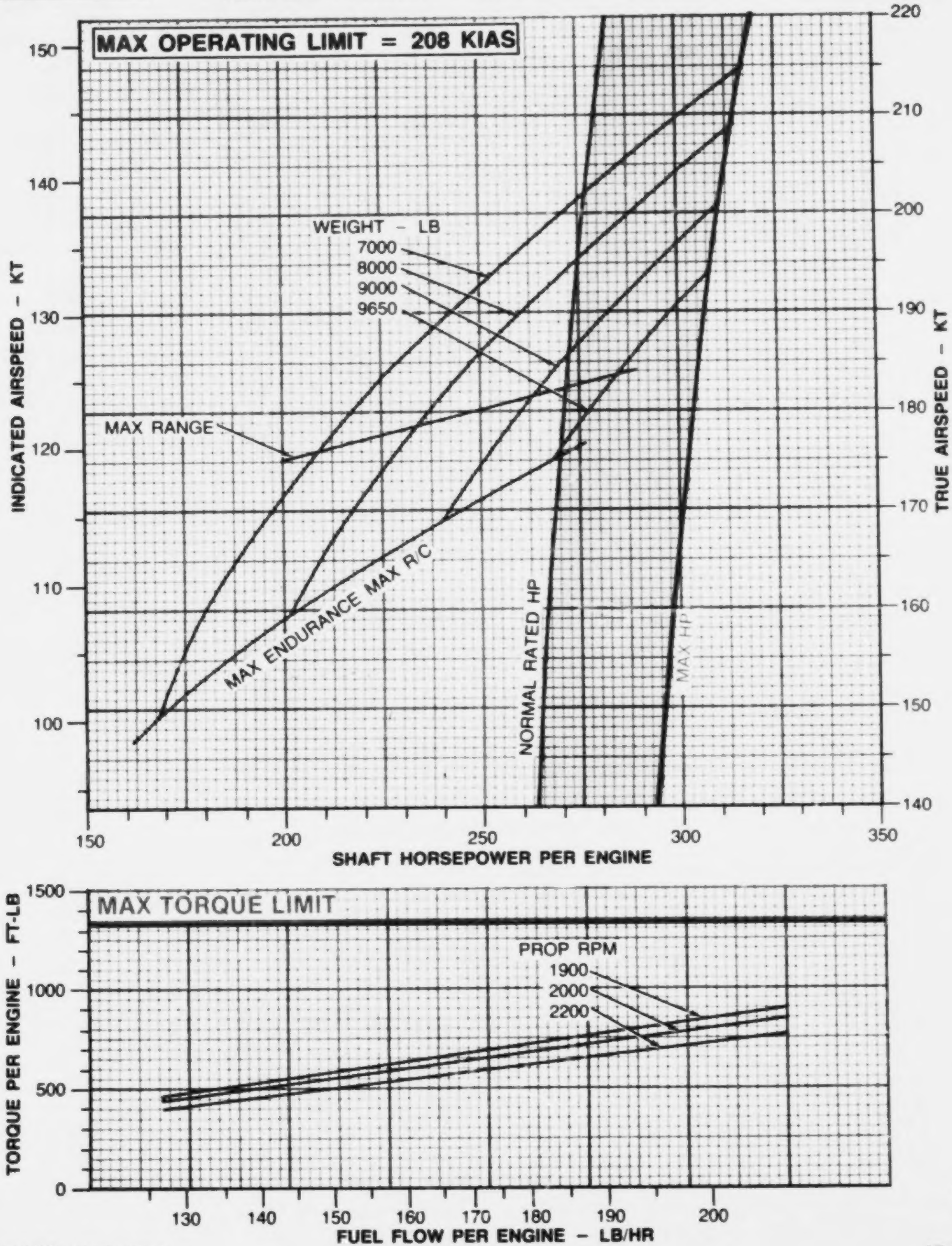
Figure 7-116. Cruise FAT −50°C, 24,000 Ft **RU-21D**

CRUISE
RU-21D
T74-CP-700

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −40°C



DATA BASIS: ESTIMATED

AP 004325

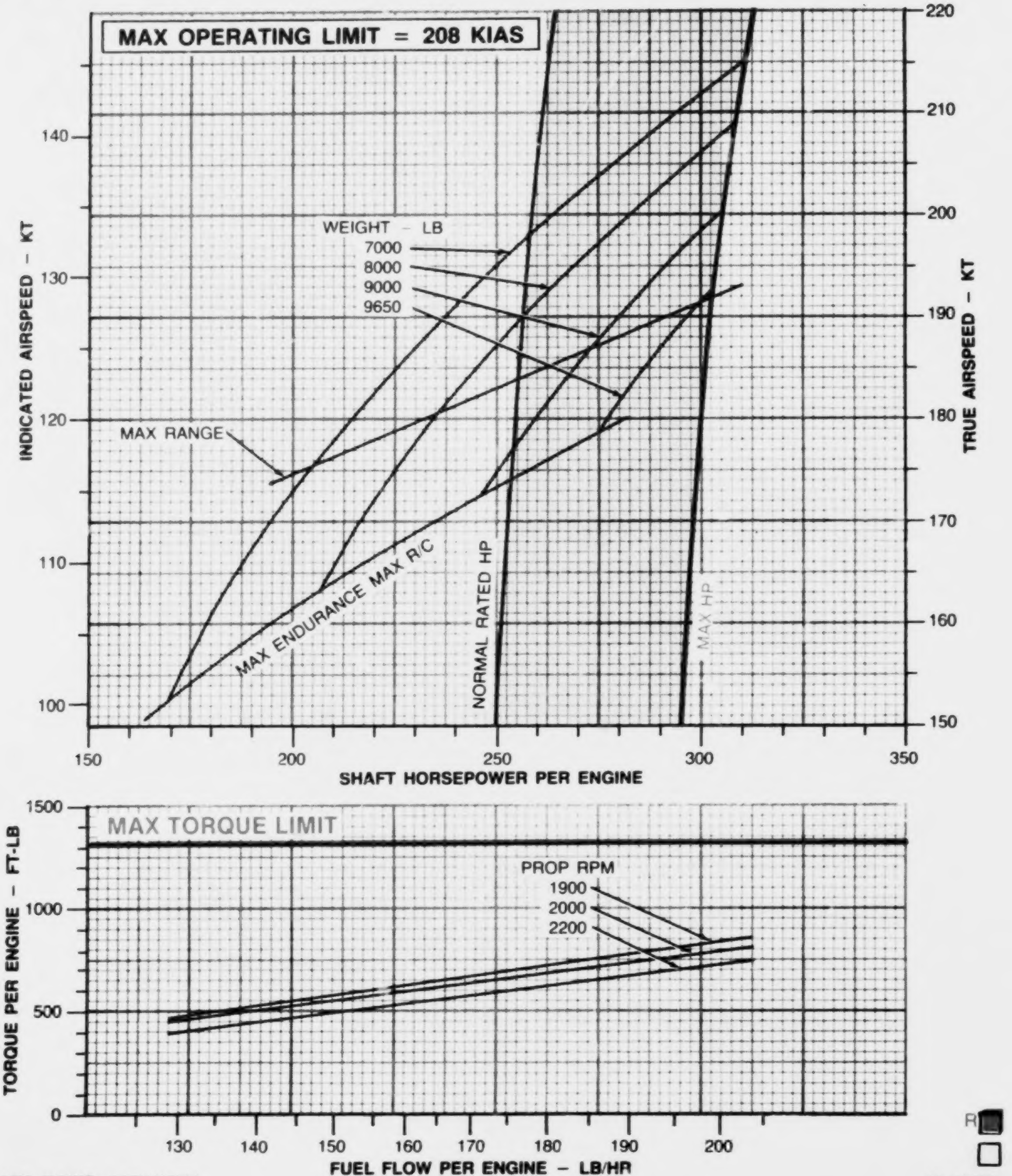
Figure 7-117. Cruise FAT −40°C, 24,000 Ft RU-21D

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C

CRUISE
RU-21D
T74-CP-700



DATA BASIS: ESTIMATED

AP 004326

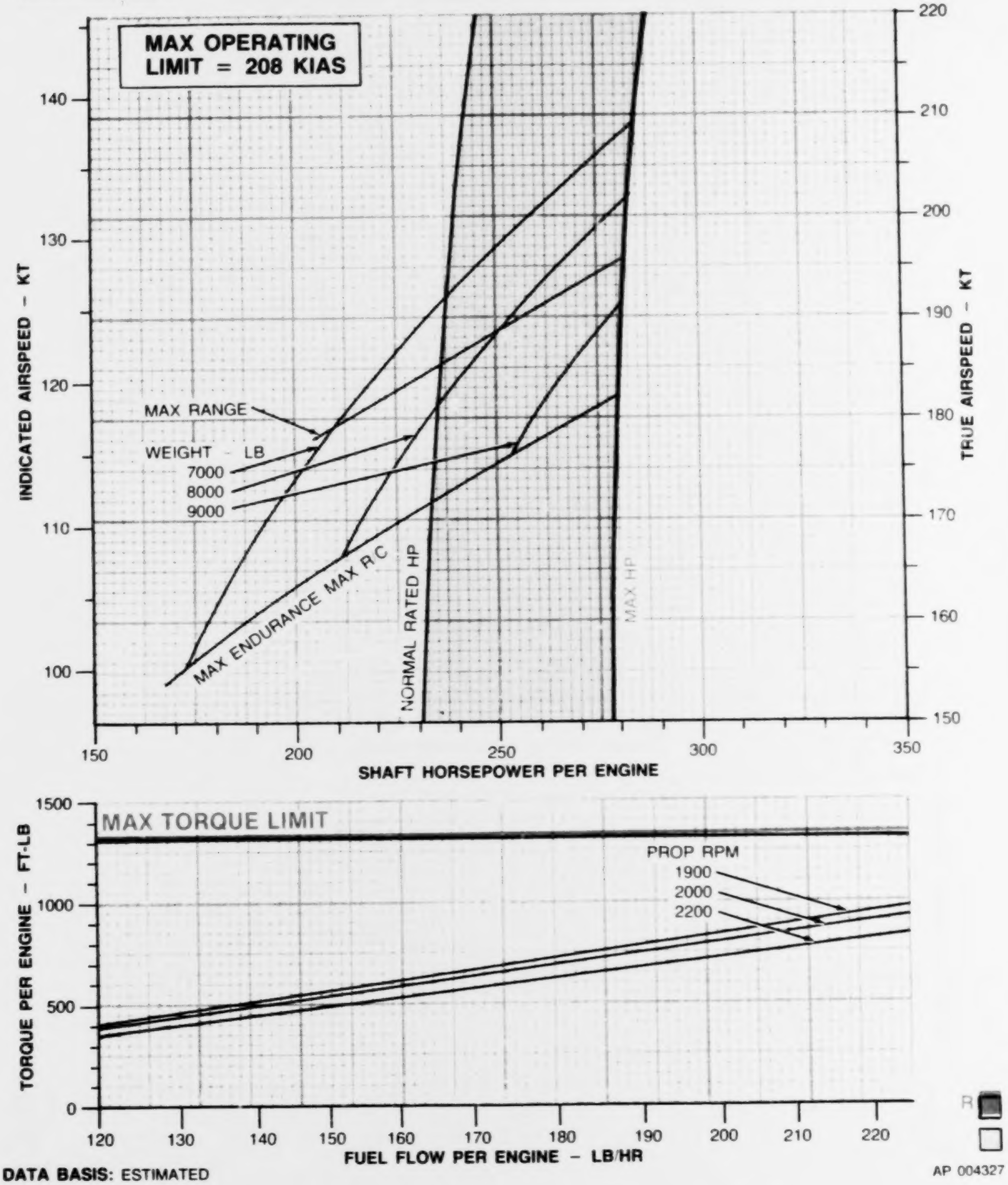
Figure 7-118. Cruise FAT −30°C, 24,000 Ft RU-21D

CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 24,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −20°C



DATA BASIS: ESTIMATED

AP 004327

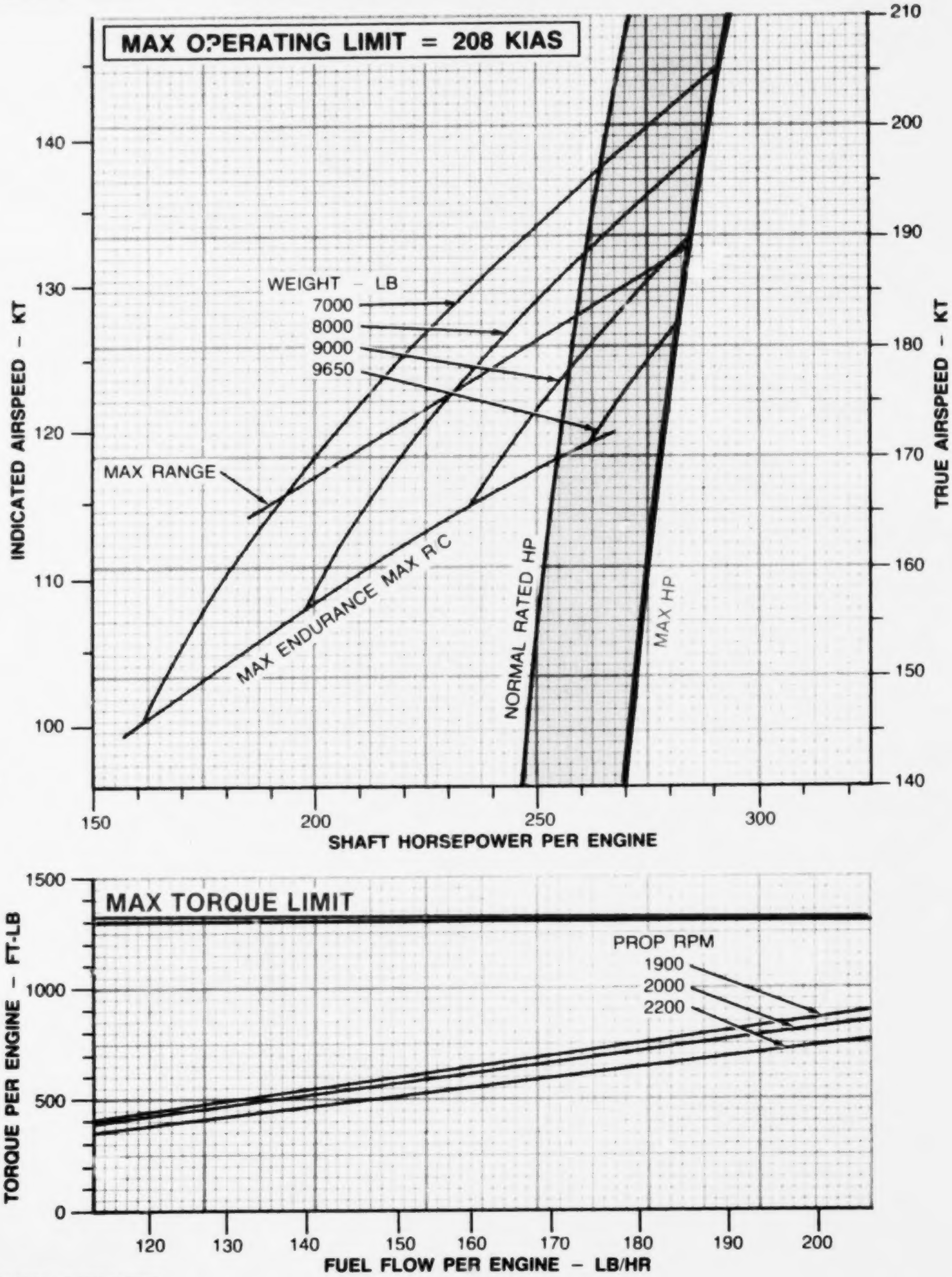
Figure 7-119. Cruise FAT −20°C, 24,000 Ft RU-21D

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = −60°C



DATA BASIS: ESTIMATED

AP 004328

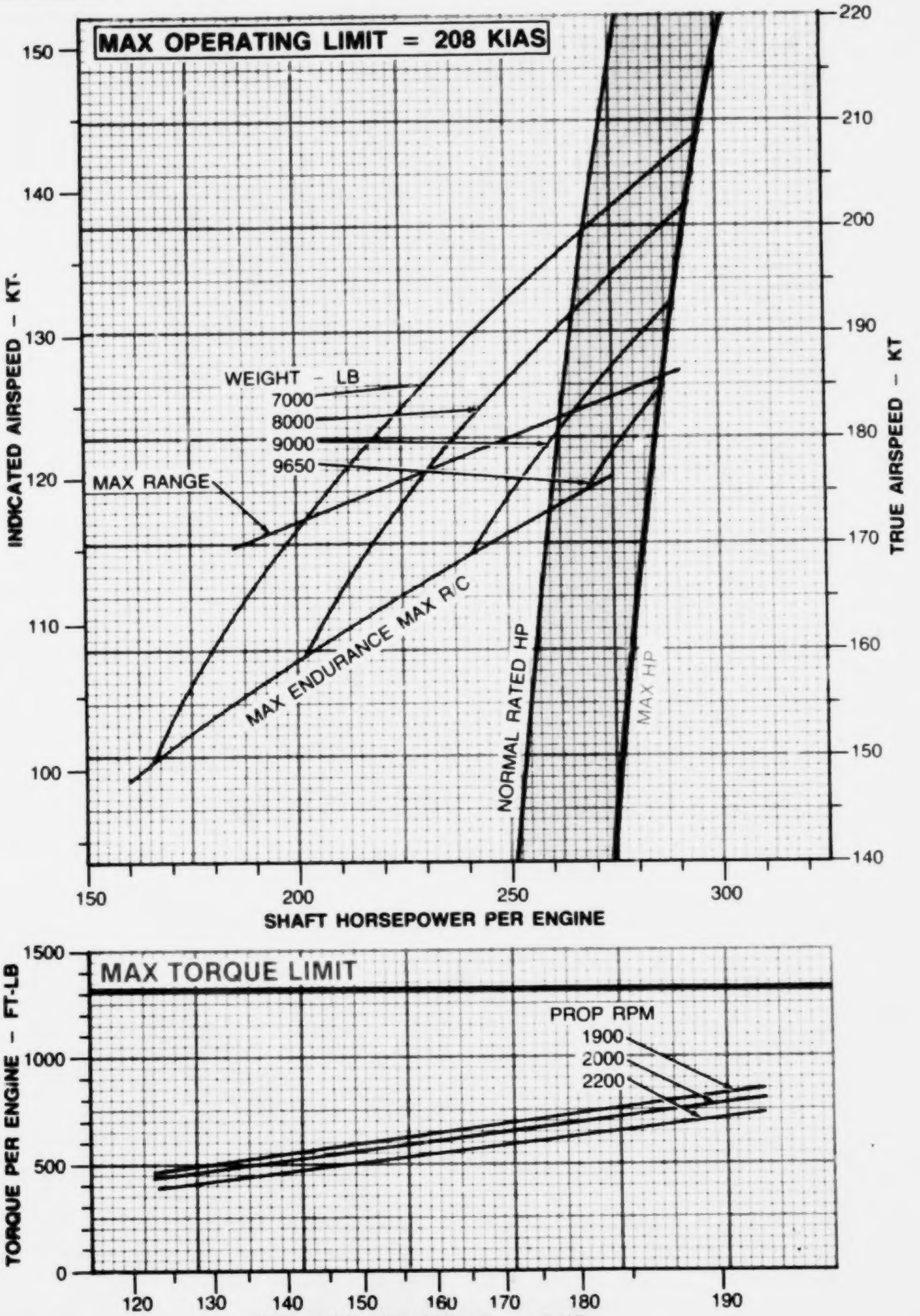
Figure 7-120. Cruise FAT −60°C, 25,000 Ft **RU-21D**

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700

FAT = −50°C



DATA BASIS: ESTIMATED

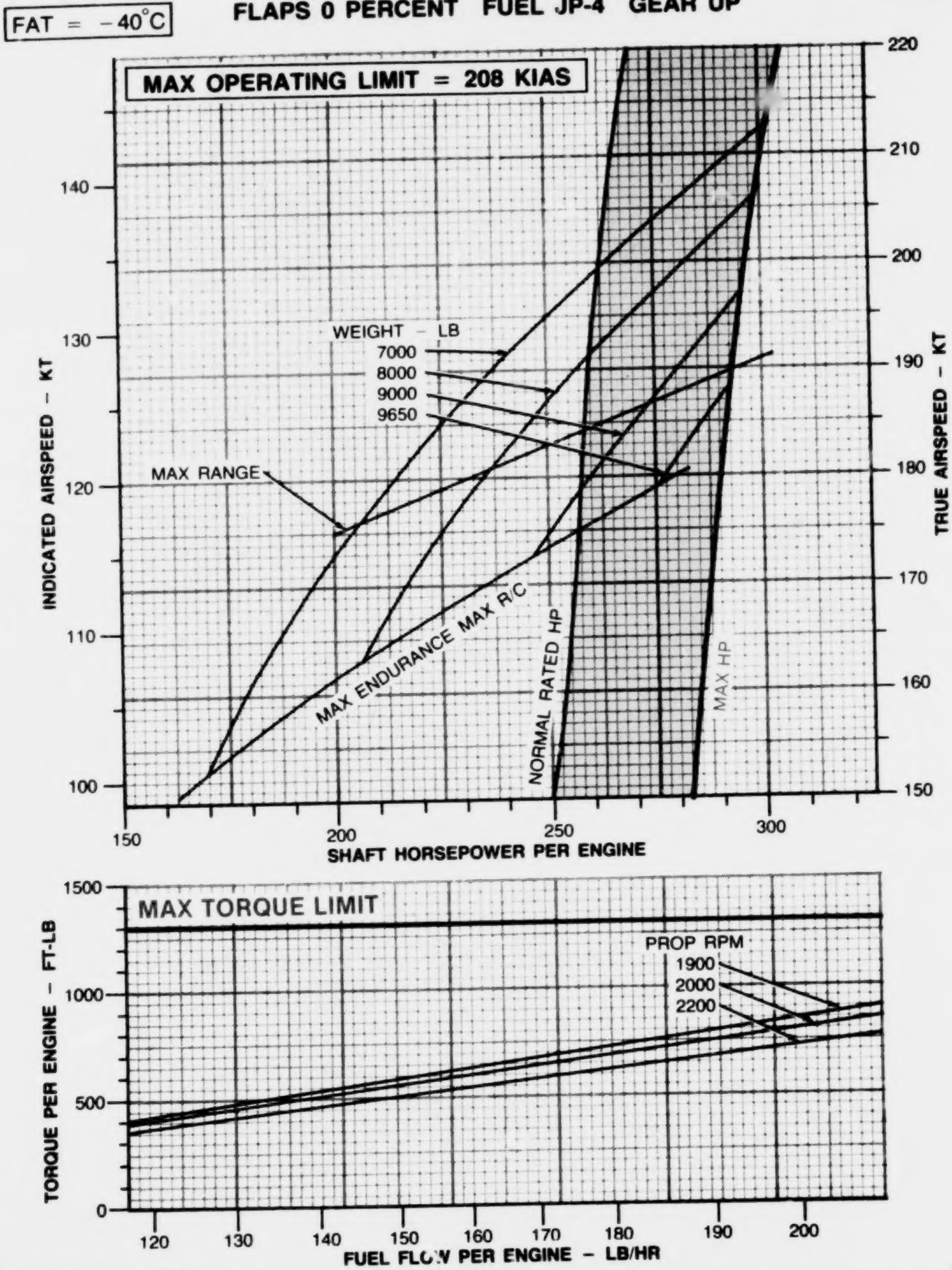
AP 004329

Figure 7-121. Cruise FAT −50°C, 25,000 Ft RU-21D

CRUISE

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

CRUISE
RU-21D
T74-CP-700



DATA BASIS: ESTIMATED

AP 004330

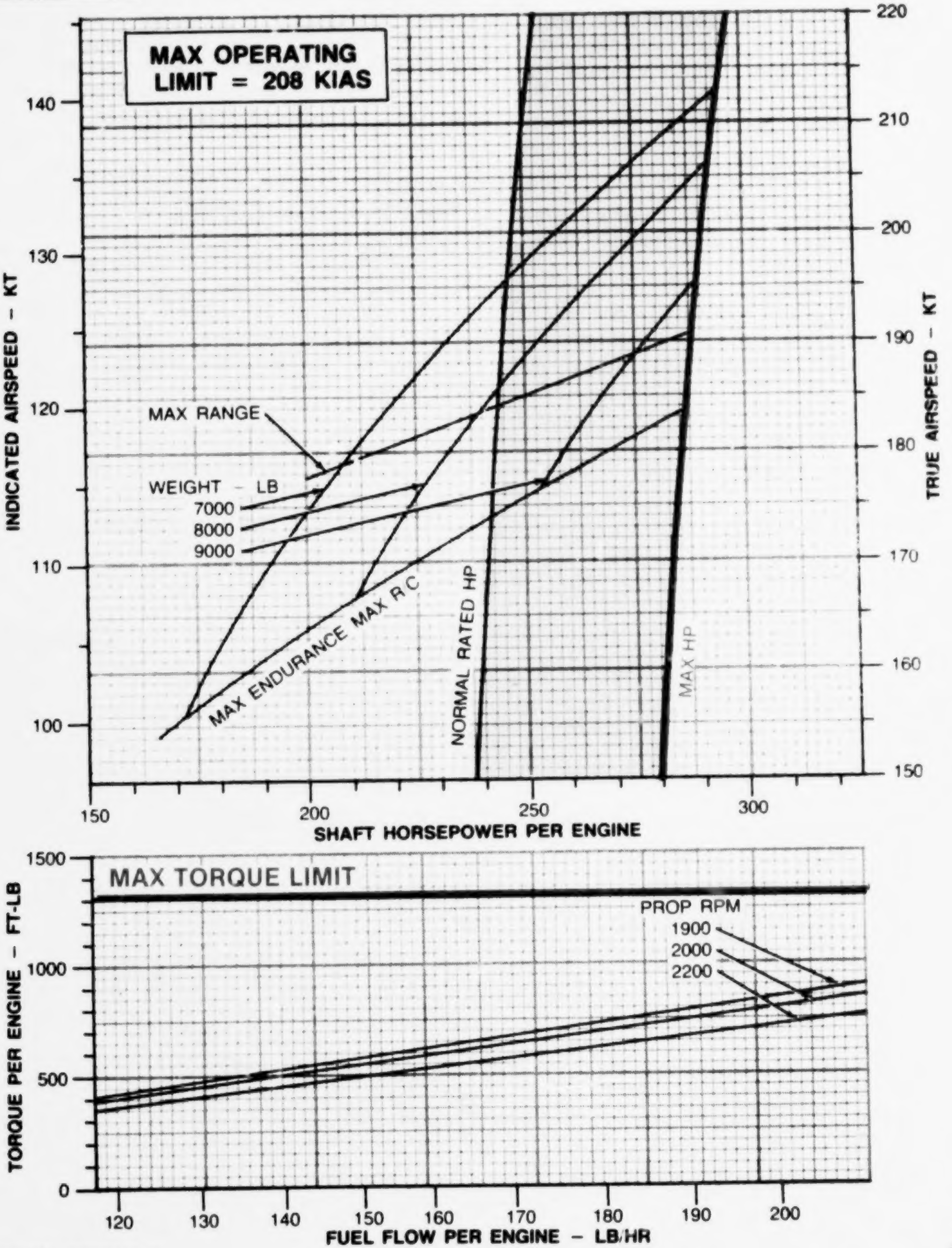
Figure 7-122. Cruise FAT −40°C, 25,000 Ft RU-21D

CRUISE

CRUISE
RU-21D
T74-CP-700

TWIN ENGINE
PRESSURE ALTITUDE 25,000 FEET
FLAPS 0 PERCENT FUEL JP-4 GEAR UP

FAT = −30°C



DATA BASIS: ESTIMATED

AP 004331

Figure 7-123. Cruise FAT −30°C, 25,000 Ft RU-21D

Section XV. CLIMB/DESCENT

7-84. Description. RU-21A

The Climb/Descent Chart (fig. 7-124), shows the rate of climb or descent at a given weight for a change in horsepower per engine. Two-engine and single-engine operation is shown.

7-85. Use of the Chart. RU-21A

The horsepower per engine required for level flight is obtained from the appropriate Cruise Chart (fig. 7-27 thru 7-74).

a. Climb. The horsepower change per engine is that additional power needed to obtain the desired rate of climb at a known weight. The excess horsepower available is obtained from the appropriate Cruise Chart (fig. 7-27 thru 7-74).

b. Descent. The horsepower change per engine is that decrease in power needed to obtain a desired rate of descent. Determine torque and propeller speed from cruise charts.

7-86. Conditions. RU-21A

a. Power - Maximum climb power.

b. Rate of climb/descent will change as altitude and temperature change. Re-evaluate as altitude and temperature change.

CLIMB/DESCENT

CLIMB/DESCENT
RU-21A
T74-CP-700

EXAMPLE

WANTED

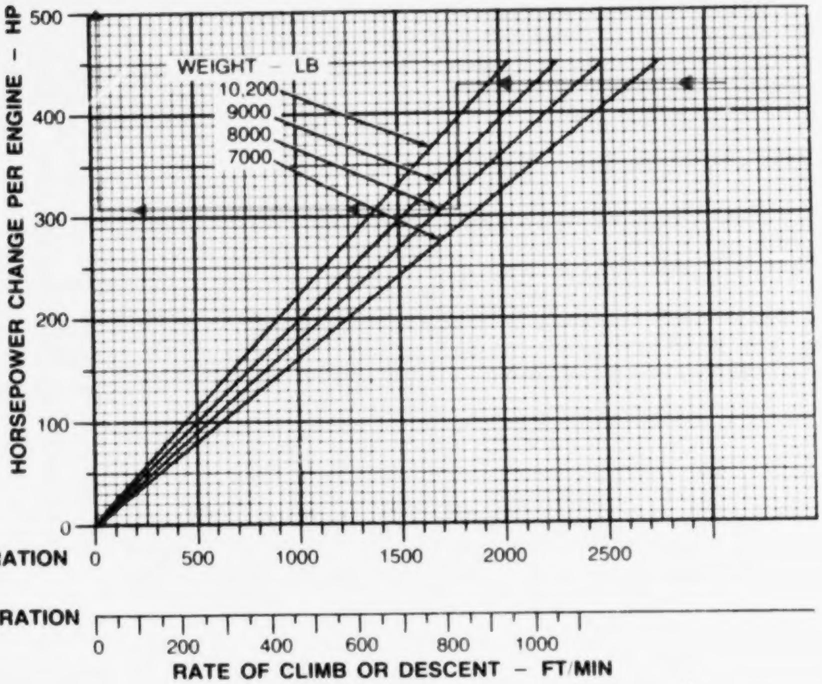
RATE OF CLIMB OR DESCENT AS A RESULT OF CHANGE IN HORSEPOWER

KNOWN

HORSEPOWER CHANGE = 200 HP
GROSS WEIGHT = 9000 LB

METHOD

ENTER HORSEPOWER CHANGE HERE
MOVE RIGHT TO GROSS WEIGHT = 9000 LBS
MOVE DOWN, READ RATE OF CLIMB OR DESCENT = 1020 FT/MIN



EXAMPLE

WANTED

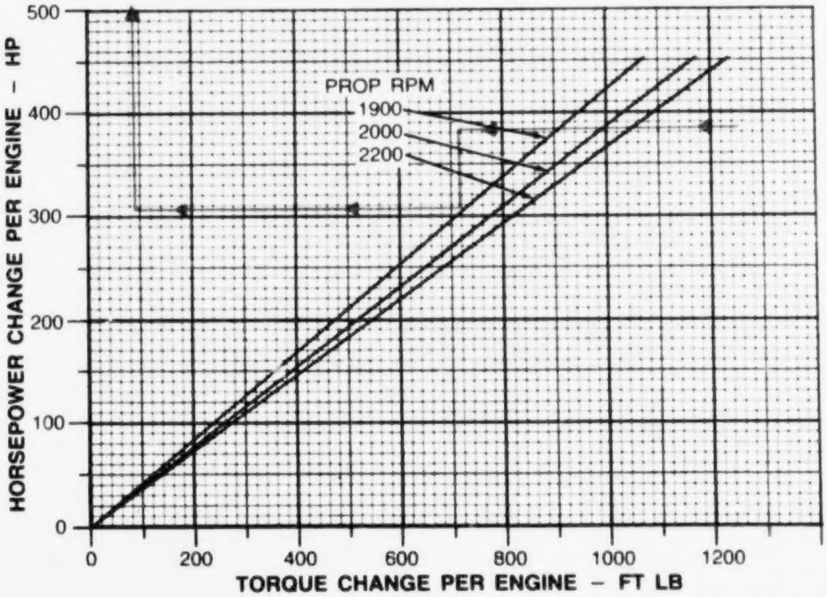
TORQUE CHANGE FOR CLIMB OR DESCENT AS A RESULT OF CHANGE IN HORSEPOWER AND RPM

KNOWN

HORSEPOWER CHANGE = 200 HP
PROP RPM = 1900 RPM

METHOD

ENTER HORSEPOWER CHANGE HERE
MOVE RIGHT TO RPM = 1900 RPM
MOVE DOWN, READ TORQUE CHANGE PER ENGINE = 480 FT LB



DATA BASIS: ESTIMATED

AP 001378

Figure 7-124. Climb/Descent **RU-21A**

7-87. Description. RU-21D

The Climb/Descent Chart (fig. 7-125), shows the rate of climb or descent at a given weight for a change in horsepower per engine. Two-engine and single-engine operation is shown.

7-88. Use of the Chart. RU-21D

The horsepower per engine required for level flight is obtained from the appropriate Cruise Chart (fig. 7-75 thru 7-123).

a. Climb. The horsepower change per engine is that additional power needed to obtain the desired rate of climb at a known weight. The excess horsepower available is obtained from the appropriate Cruise Chart (fig. 7-75 thru 7-123).

b. Descent. The horsepower change per engine is that decrease in power needed to obtain a desired rate of descent. Determine torque and propeller speed from cruise charts.

7-89. Conditions. RU-21D

a. Power - Maximum climb power.

b. Rate of climb/descent will change as altitude and temperature change. Re-evaluate as altitude and temperature change.

CLIMB/DESCENT

CLIMB/DESCENT
RU-21D
T74-CP-702

EXAMPLE

WANTED

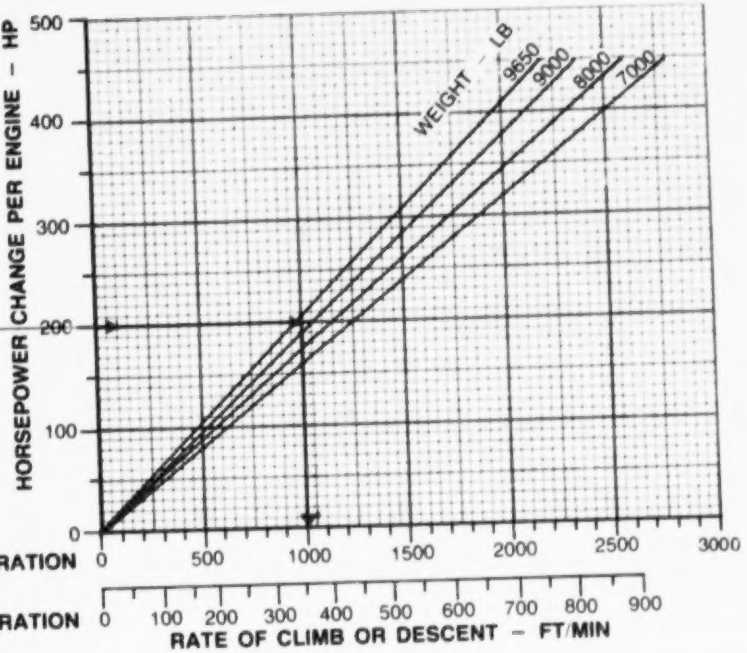
RATE OF CLIMB OR DESCENT AS A RESULT OF CHANGE IN HORSEPOWER

KNOWN

HORSEPOWER CHANGE = 200 HP
WEIGHT = 9000 LB

METHOD

ENTER HORSEPOWER CHANGE HERE
MOVE RIGHT TO WEIGHT = 9000 LB
MOVE DOWN, READ RATE OF CLIMB OR DESCENT = 1050 FT/MIN



EXAMPLE

WANTED

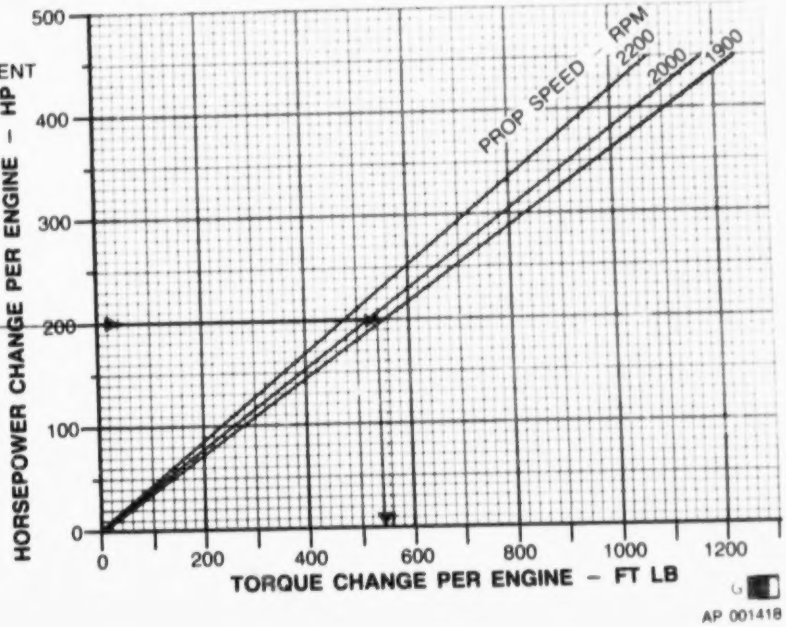
TORQUE CHANGE FOR CLIMB OR DESCENT AS A RESULT OF CHANGE IN HORSEPOWER OR RPM

KNOWN

HORSEPOWER CHANGE = 200
PROP RPM = 1900 RPM

METHOD

ENTER HORSEPOWER CHANGE HERE
MOVE RIGHT TO RPM = 1900 RPM
MOVE DOWN, READ TORQUE CHANGE PER ENGINE = 560 FT LB



DATA BASIS: CALCULATED

Figure 7-125. Climb Descent **RU-21D**

Section XVI. APPROACH SPEED

7-90. Description. RU-21A

The Approach Speed Chart (fig. 7-126), shows the variation of approach speed with weight for flaps up and flaps down operation. The landing approach speed (V_{ref}) is the indicated airspeed the aircraft should be at, when fifty feet above the runway in landing configuration.

7-91. Use of Chart. RU-21A

The approach speed line shows the indicated approach airspeed to use for a given aircraft weight.

7-92. Condition. RU-21A

a. Speeds. These speeds have been selected to provide adequate margins above the stall speeds for the appropriate flap settings.

b. Landing Chart. Performance scheduled on the Landing Chart (fig. 7-128), is based on use of these speeds.

c. Touchdown. The touchdown shall be accomplished at speeds less than those scheduled. Consideration shall be given to the appropriate stall speed from the Stall Speed Chart (fig. 8-3) and to the minimum touchdown speed needed to remain within the recommended area on the Crosswind-Takeoff or Landing Chart (fig. 7-7).

APPROACH SPEED

GEAR DOWN

APPROACH SPEED
RU-21A
T74-CP-700

EXAMPLE

WANTED

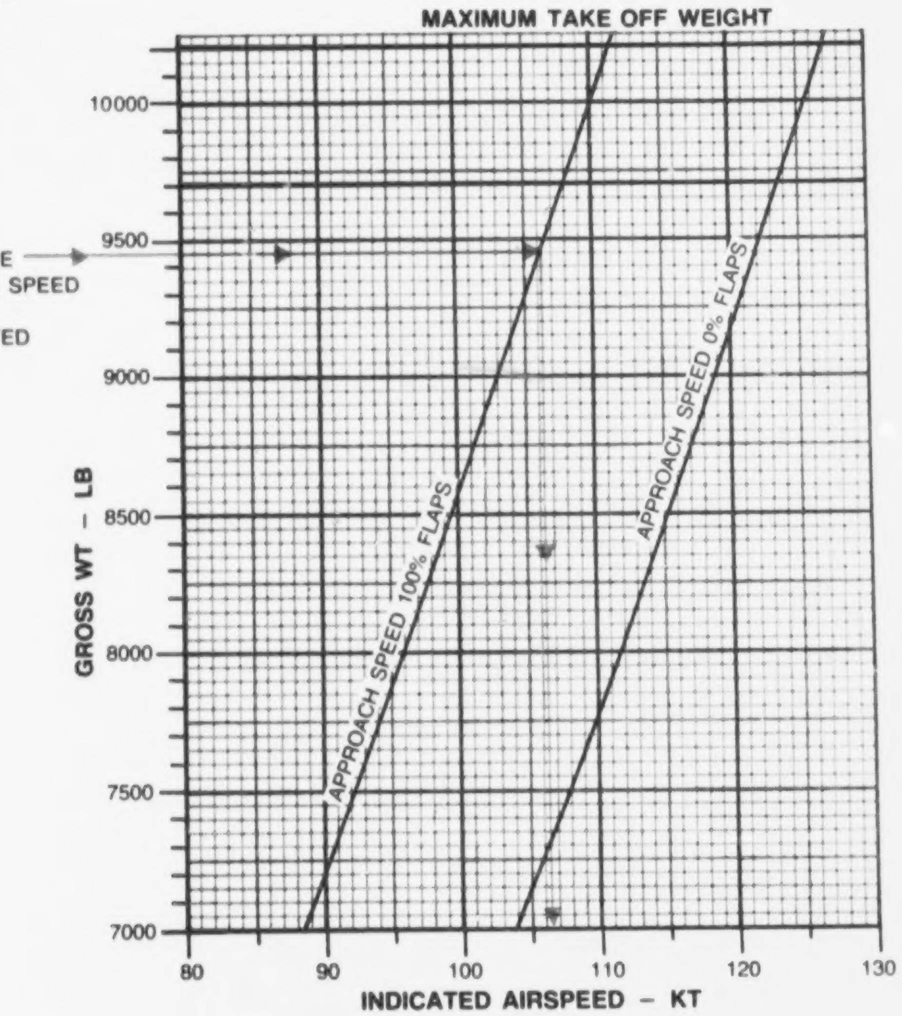
RECOMMENDED APPROACH SPEED
FOR KNOWN GROSS WEIGHTS

KNOWN

GROSS WEIGHT 9443 LB
FLAP SETTING 100%

METHOD

ENTER GROSS WEIGHT HERE
MOVE RIGHT TO APPROACH SPEED
LINE 100% FLAPS
MOVE DOWN, READ INDICATED
AIRSPEED = 106 KT



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AP 001379

DATA BASIS: ESTIMATED

Figure 7-126. Approach Speed **RU-21A**

7-93. Description. RU-21D

The Approach Speed Chart (fig. 7-127), shows the variation of approach speed with weight for flaps up and flaps down operation. The landing approach speed (V_{ref}) is the indicated airspeed the aircraft should be at, when fifty feet above the runway in landing configuration.

7-94. Use of Chart. RU-21D

The approach speed line shows the indicated approach airspeed to use for a given aircraft weight.

7-95. Condition. RU-21D

a. Speeds. These speeds have been selected to provide adequate margins above the stall speeds for the appropriate flap settings.

b. Landing Chart. Performance scheduled on the Landing Chart (fig. 7-129), is based on use of these speeds.

c. Touchdown. The touchdown shall be accomplished at speeds less than those scheduled. Consideration shall be given to the appropriate stall speed from the Stall Speed Chart (fig. 8-4) and to the minimum touchdown speed needed to remain within the recommended area on the Crosswind-Takeoff or Landing Chart (fig. 7-8).

APPROACH SPEED

GEAR DOWN

APPROACH SPEED
RU-21D
T74-CP-700

EXAMPLE

WANTED

RECOMMENDED APPROACH SPEED FOR KNOWN WEIGHT

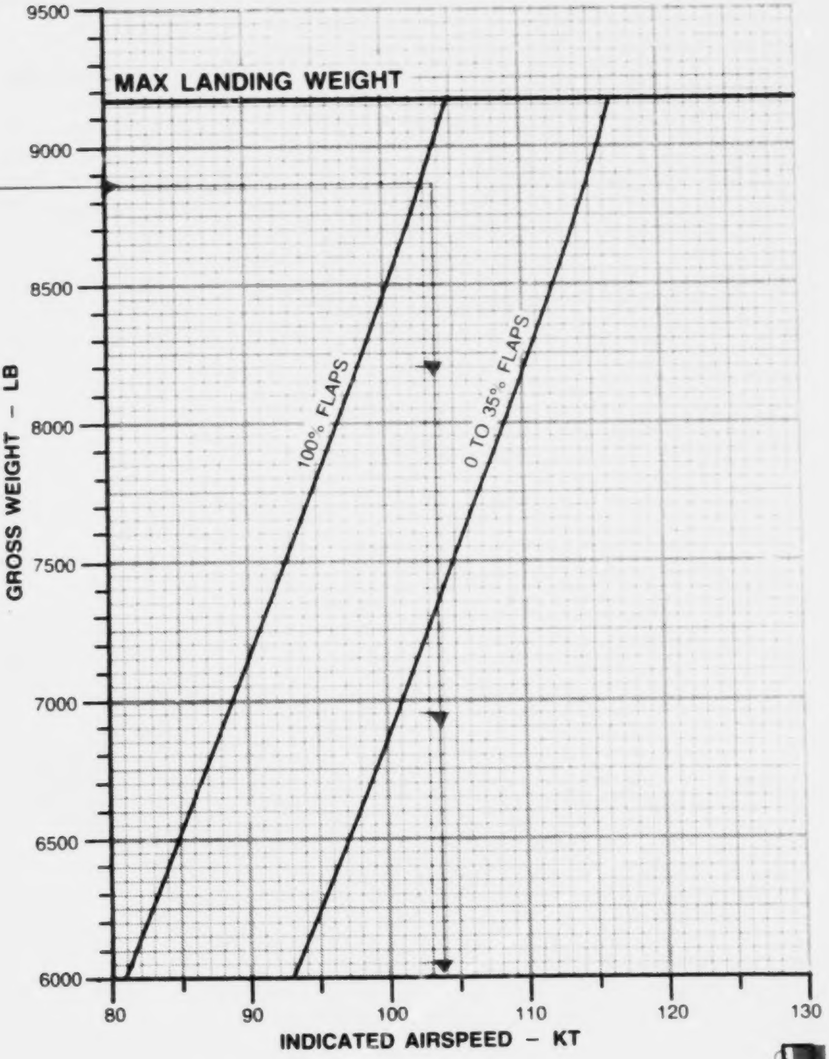
KNOWN

WEIGHT = 8855 LB

FLAP SETTING = DOWN

METHOD

ENTER WEIGHT HERE
MOVE RIGHT TO APPROACH SPEED LINE, FLAPS DOWN
MOVE DOWN, READ INDICATED AIRSPEED = 103 KT



AP 001419

DATA BASIS: FLIGHT TEST

Figure 7-127. Approach Speed **RU-21D**

Section XVII. LANDING

7-96. Description. RU-21A

The Landing Chart (fig. 7-128), shows the total ground roll distance required for varying air temperatures, altitudes, weights and flap positions.

NOTE

Landing data is provided up to weights of 10,200 pounds in the event emergency landing is required immediately after takeoff. Anytime the maximum landing weight of 9,700 pounds is exceeded, an appropriate entry shall be made on DA Form 2408-13.

7-97. Use of Chart. RU-21A

The Landing Chart is used to obtain the total ground roll distance required for landing. Performance is based on the approach speed obtained from the Approach Speed Chart (fig. 7-126).

7-98. Conditions. RU-21A

a. Power – As required (on final approach).

b. Flaps – As selected.

c. Landing Gear – DN.

d. Technique – Establish 800 FT/MIN descent on final approach at the appropriate airspeed from the Approach Speed Chart (fig. 7-126). When landing is assured, reduce power and speed.

e. Runway – Runway conditions for this chart are based on a dry, level, hard-surface. Conditions other than these may vary aircraft landing distance. Distance decreases approximately 4% per 1% uphill gradient. Distance increases approximately 4% per 1% downhill gradient.

f. Wind – All data presented are based on calm wind conditions. Distance decreases approximately 1% per knot headwind. Distance increases approximately 4% per knot tailwind.

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LANDING

CALM WINDS LEVEL, DRY, HARD SURFACE

LANDING
RU-21A
T74-CP-700

EXAMPLE

WANTED

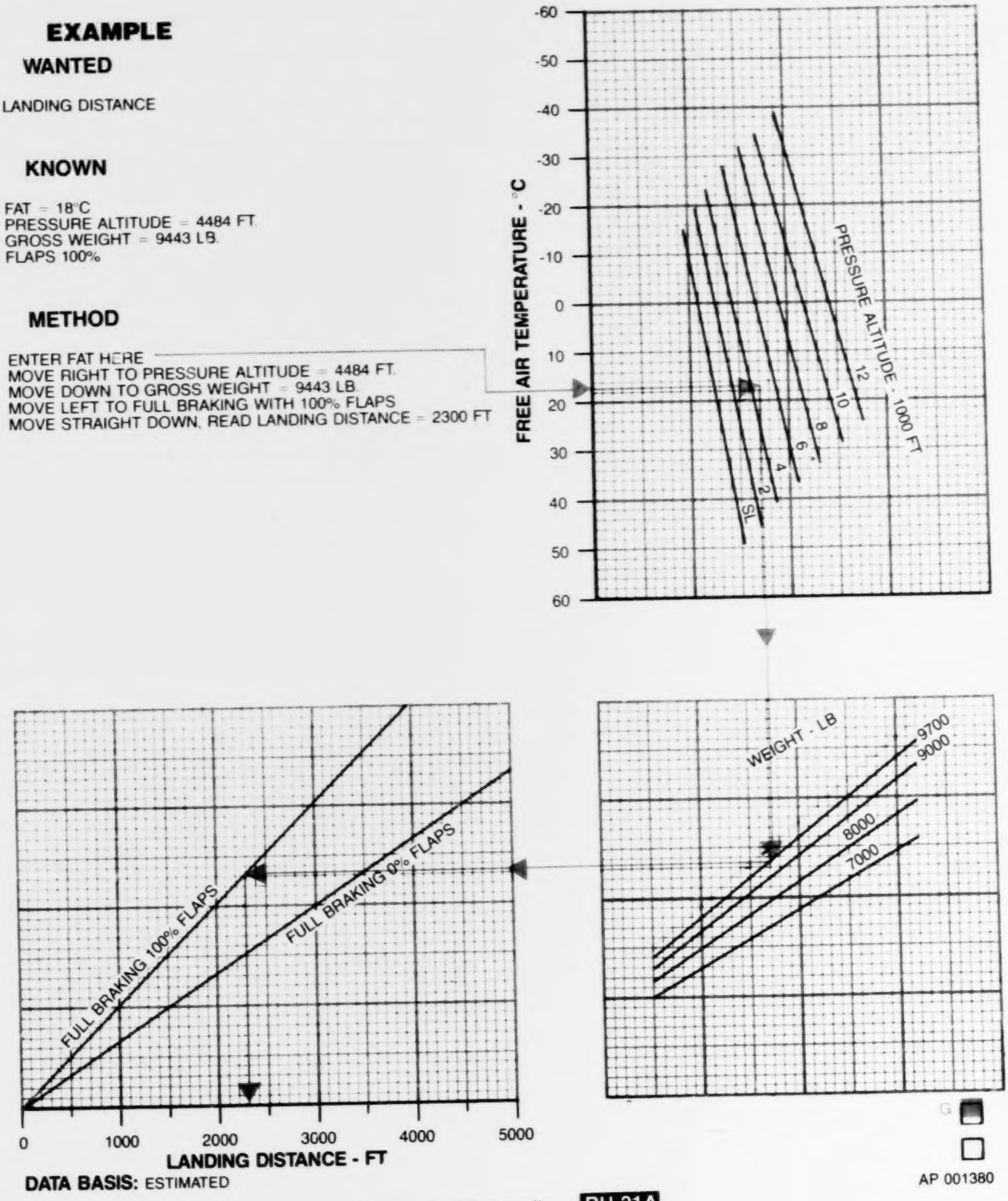
LANDING DISTANCE

KNOWN

FAT = 18°C
PRESSURE ALTITUDE = 4484 FT.
GROSS WEIGHT = 9443 LB.
FLAPS 100%

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4484 FT.
MOVE DOWN TO GROSS WEIGHT = 9443 LB.
MOVE LEFT TO FULL BRAKING WITH 100% FLAPS
MOVE STRAIGHT DOWN, READ LANDING DISTANCE = 2300 FT



DATA BASIS: ESTIMATED

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AP 001380

Figure 7-128. Landing **RU-21A**

7-99. Description. RU-21D

The Landing Chart (fig. 7-129), shows the total ground roll distance required for varying air temperatures, altitudes, weights and flap positions.

NOTE

Landing data is provided up to weights of 9,650 pounds in the event emergency landing is required immediately after takeoff. Anytime the maximum landing weight of 9,168 pounds is exceeded, an appropriate entry shall be made on DA Form 2408-13.

7-100. Use of Chart. RU-21D

Performance is based on the approach speed obtained from the Approach Speed Chart (fig. 7-127).

7-101. Conditions. RU-21D

a. Power – As required (on final approach).

b. Flaps – As selected.

c. Landing Gear – DN.

d. Technique – Establish 800 FT/MIN descent on final approach at the appropriate airspeed from the Approach Speed Chart (fig. 7-127). When landing is assured, reduce power and speed.

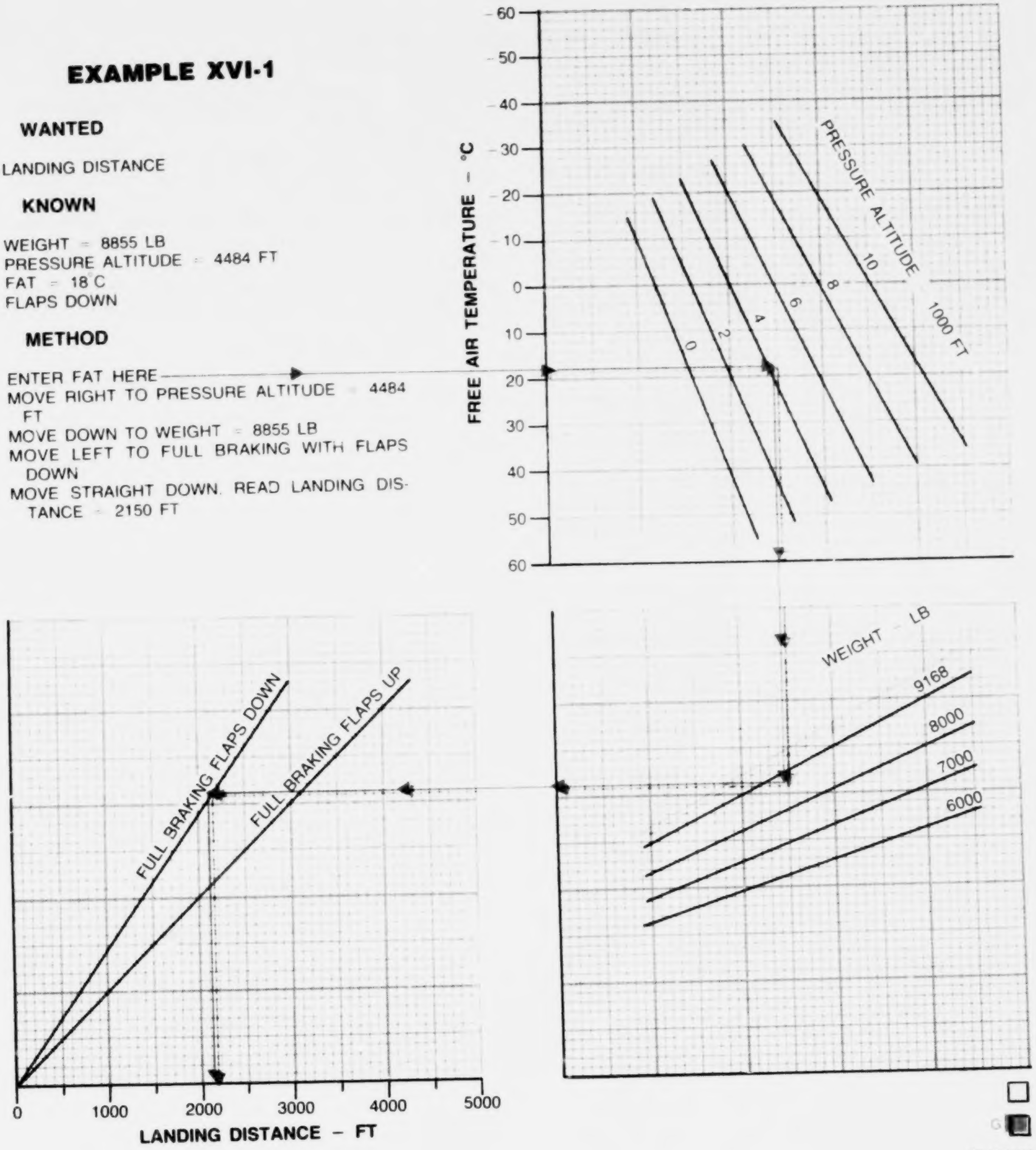
e. Runway – Runway conditions for this chart are based on a dry, level, hard-surface. Conditions other than these may vary aircraft landing distance. Distance decreases approximately 4% per 1% uphill gradient. Distance increases approximately 4% per 1% downhill gradient.

f. Wind – All data presented are based on calm wind conditions. Distance decreases approximately 1% per knot headwind. Distance increases approximately 4% per knot tailwind.

LANDING

CALM WINDS LEVEL, DRY, HARD SURFACE

LANDING
RU-21D
T74-CP-700



EXAMPLE XVI-1

WANTED

LANDING DISTANCE

KNOWN

WEIGHT = 8855 LB
PRESSURE ALTITUDE = 4484 FT
FAT = 18 C
FLAPS DOWN

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE = 4484 FT
MOVE DOWN TO WEIGHT = 8855 LB
MOVE LEFT TO FULL BRAKING WITH FLAPS DOWN
MOVE STRAIGHT DOWN. READ LANDING DISTANCE = 2150 FT

DATA BASIS: CALCULATED

Figure 7-129. Landing **RU-21D**

CHAPTER 8

NORMAL PROCEDURES

Section I. MISSION PLANNING

8-1. Mission Planning.

Mission planning begins when the mission is assigned and extends to the preflight check of the aircraft. It includes, but is not limited to checks of operating limits and restrictions; weight/balance and loading; performance; publications; flight plan and crew and passenger briefings. The pilot in command shall insure compliance with the contents of this manual that are applicable to the mission.

8-2. Operating Limits and Restrictions.

The minimum, maximum, normal and cautionary operational ranges represent careful aerodynamic and structural calculations, substantiated by flight test data. These limitations must be adhered to during all phases of the mission. Refer to Chapter 5, OPERATING LIMITS AND RESTRICTIONS, for detailed information.

8-3. Weight/Balance and Loading.

The aircraft must be loaded, cargo and passengers secured, and weight and balance verified in accordance with Chapter 6, WEIGHT/BALANCE AND LOADING. This aircraft is in weight and balance class I and requires a weight and balance clearance when loaded in other than a normal manner in accordance with AR 95-16. The aircraft weight and center of gravity conditions must be within the limits prescribed in Chapter 5, OPERATING LIMITS AND RESTRICTIONS.

8-4. Performance.

Refer to Chapter 7, PERFORMANCE DATA, to determine the capability of the aircraft for the entire mission. Consideration must be given to changes in performance resulting from variations in loads, temperatures, and pressure altitudes. Record the data on the Performance Planning Card for use in completing the flight plan and for reference throughout the mission.

8-5. Flight Plan.

A flight plan shall be completed and filed in accordance with AR 95-1, DOD FLIP, and local regulations.

8-6. Crew/Passenger Briefings.

A crew/passenger briefing shall be conducted to insure a thorough understanding of individual and team responsibilities. The briefing should include the copilot and ground crew responsibilities and the coordination necessary to complete the mission in the most efficient manner. A review of visual signals is desirable when ground guides do not have a direct voice communications link with the crew. Refer to Section VI for crew/passenger briefing.

Section II. OPERATING PROCEDURES AND MANEUVERS

8-7. Operating Procedures and Maneuvers.

a. This section deals with normal procedures and includes all steps necessary to insure safe and efficient operation of the aircraft from the time a preflight begins until the flight is completed and the aircraft is parked and secured. Unique feel, characteristics and reaction of the aircraft during various phases of operation and the techniques and procedures used for taxiing, takeoff, climb, etc., are described including precautions to be observed. Your flying experience is recognized; therefore, basic flight principles are avoided. Only the duties of the minimum crew necessary for the actual operation of the aircraft are included.

b. Additional crew duties are covered as necessary in Section VI, CREW DUTIES. Procedures specifically related to instrument flight that are different from normal procedures are covered in this section following normal procedures. Descriptions of functions, operations, and effects of controls are covered in Section III, FLIGHT CHARACTERISTICS, and are repeated in this section only when required for emphasis. Checks that must be performed under adverse environmental conditions such as desert and cold weather operations supplement normal procedures checks in this section and are covered in Section V, ADVERSE ENVIRONMENTAL CONDITIONS.

8-8. Symbols Definition.

Items which apply only to night or only to instrument flying shall have an "N" or an "I", resepectively, immediately preceding the check to which it is pertinent. The symbol "O" shall be used to indicate "if installed". Those duties which are the responsibility of the copilot, will be indicated by a circle around the step number i.e.,④Starter and IGN SYS circuit breakers – IN. The symbol star "★" indicates an operational check is required. Operational checks are contained in the performance section of the condensed checklist. The symbol asterisk "*" indicates that performance of step is mandatory for all thru-flights, when there has been no change in crew. The asterisk applies only to checks performed prior to takeoff. Placarded items appear in upper case.

8-9. Checklist.

Normal procedures are given primarily in checklist form and amplified as necessary in accompanying paragraph form when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the Operator's and Crewmember's Checklist, TM 55-1510-209-CL-1. To provide for easier cross referencing the procedual steps are numbered to coincide with the corresponding numbered steps in this manual.

8-10. Checklist Callout.

Pilot and crewmembers shall not rely on memory for verifying prescribed operational checks, except those immediate action emergency checks that must be memorized for safe procedures that must be memorized for safe aircraft emergency operation. Oral callout and confirmation of checklist items shall be accomplished by pilot and the crewmembers.

8-11. Preflight Check.

The preflight check is performed as follows:

NOTE

If ferry fuel system is used, refer to Chapter 2 for complete operating and emergency procedures.

a. Before Exterior Check.

* 1. Publications – Check DA Form 2408-12, -13, -14 and availability of DOD AVFUEL Identaplate DD Form 1896, Operator's Manual (-10), Checklist (-CL) and locally required forms and publications.

* 2. Oxygen system pressure gages – Check.

3. Keylock switch – Off.

4. Fuel firewall valves – OPEN and safetied.

CAUTION

If high or gusty winds are present, and the flight controls are unlocked, control surfaces may be damaged by buffeting.

5. Flight controls – Unlocked.

6. Parking brake – Set.

7. Trim tabs – Zero.

CAUTION

Do not cycle landing gear handle on the ground.

* 8. Gear Handle – Down.

* 9. Battery – ON (stabilized at 22 volts minimum).

10. Rotating beacons – Check illumination and rotation.

11. Lighting systems – Check as required.

★ 12. Pitot and stall warning heat system – Check.

(1) Pitot and stall warning heat switch – On (check pitot cover removed).

(2) Pitot tube – Check by feel for heat and free of obstructions.

(3) Stall warning vane – Check by feel for heat, condition and operation.

(4) Pitot and stall warning heat switch – OFF.

13. Battery – OFF.

14. Safety belts, shoulder harnesses, inertia reels – Check condition and operation.

15. Fire extinguishers (2) – Check.

16. Fire axe – Secured.

17. First aid kits (5) – Check.

18. Mission/INS equipment – Secured.

b. *Exterior Check (fig. 8-1).*

NOTE

Fuel and oil quantity, and empennage dipole antennas check may be performed prior to EXTERIOR CHECK to preclude carrying ladder around during the inspection.

(1) Fuel and antennas.

WARNING

If fuel is detected at transfer pump or boost pump seal drain tube, a fire hazard exists.

* 1. Fuel sample – Check collective fuel sample for contamination.

2. Antenna configuration – Check mission capability.

(2) Left wing.

1. Skin condition – Check for skin damage such as buckling, cracking, splitting, distortion, dents, or fuel leaks.

2. Controls, flaps and trim tabs – Check hinge attachment and trim tab rig.

3. Static wicks – Check for security of discharge wicks.

(O) 4. Wing antenna pod – Check for cracks and dents.

(O) 5. Wing pod navigation lights (2) – Check.

(O) 6. Wing tip and navigation light – Check.

(O) 7. Antennas – Check for security; HF loading disc for cracks and damage to underside.

8. Landing light – Check.

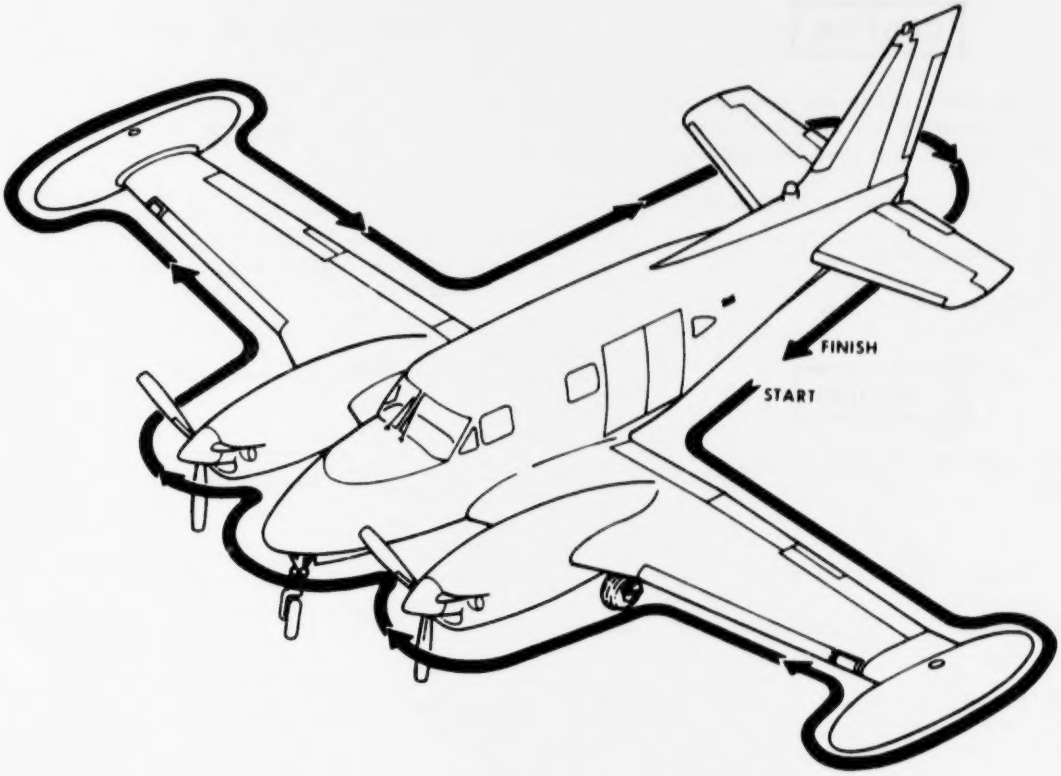


Figure 8-1. Exterior Area Check (Typical)

9. Tiedown – Released.

10. Fuel vent (1) – Check flush vent free of obstructions.

* 11. Wing tank fuel and cap – Check fuel level visually. Check seal is installed, cap is tight and properly installed (latch tab aft).

12. Deicer boot – Check bonding secure, boot free of cuts and cracks.

13. Wing ice light – Check.

14. Fuel vents (2) – Check heated and recessed vents free of obstructions (fig. 2-18).

(O) 15. Antennas – Check for security and cracks at mounting points (top and bottom of wing).

16. Inverter air intake screen and exhaust port – Check free of obstructions.

(3). Left main landing gear.

* 1. Tire – Check for cuts, bruises, wear, and proper inflation.

2. Brake assembly – Check brake lines for damage or signs of leakage, and brake linings for wear.

* 3. Shock strut – Check for signs of leakage and a **2.75 INCH EXTENSION (MINIMUM)**, L and R strut extensions approximately equal.

4. Torque knee – Check.

5. Safety switch – Check.

6. Wheel well general condition – Check.

* 7. Doors and linkage – Check.

8. Air bypass and oil cooler (rear) – Check free of obstructions and oil leaks.

9. Firewall fuel filter drain (at inertial separator duct) – Turn/release. Check for fuel drainage.

(4) Left engine and propeller.

1. Accessory section exhaust vent – Check free of obstructions.

2. Left cowl locks – Locked.

3. Left exhaust stub – Check free of obstructions.

* 4. Propeller blades and spinner – Check blades for nicks, security of spinner and free rotation.

* 5. Nacelle air intake – Check free of obstructions.

6. Nacelle lip ice boot – Check condition and security.

* 7. Oil cooler air intake – Check free of obstructions and leakage.

8. Right cowl locks – Locked.

9. Right exhaust stub – Check free of obstructions.

CAUTION

A cool oil check is unreliable. If the oil level is **LESS THAN 3 QUARTS LOW** the oil quantity is sufficient to operate the engine for total fuel duration unless engine oil consumption is excessive or a leak exists. Do not add oil. However, if cold oil check indicates **MORE THAN 3 QUARTS LOW,** motor engine 15-20 seconds, then recheck and add as required. Do not overfill.

* 10. Engine compartment – Check for fuel and oil leaks, oil level and positively secure oil cap (latch tab aft).

* 11. Nacelle tank fuel and cap – Check fuel level visually. Check seal is installed, cap is tight and properly installed (latch tab aft).

(O) 12. Fuel filter drain ring – Pull/release. Check for fuel drainage.

* 13. Engine compartment access door – Locked. Visually check locking hooks.

(O) 14. Engine wash access door – Locked.

(5) Fuselage underside.

1. General condition – Check.

2. Antennas – Check for security.

3. Rotating beacon – Check condition.

(6) Left nose avionics compartment.

(O) 1. Voice security computer – Installed/keyed.

2. Transponder – Set M-2 CODE.

3. Left nose avionics compartment access door – Secured.

4. Inverter intake screen and exhaust port – Check free of obstructions.

(7) Nose section.

1. Wheel well condition – Check for fuel and oil leaks.

2. Doors and linkage – Check.

3. Nose gear turning stop – Check condition.

* 4. Tire – Check for cuts, bruises, wear, and proper inflation.

5. Torque knee – Check.

* 6. Shock strut – Check for signs of leakage and extension of **2.75 INCHES (MINIMUM).**

7. Shimmy damper and attaching linkage – Check.

8. Taxi light – Check.

9. Radome – Check.

10. Windshield and wipers – Check.

11. Ram air intake – Check free of obstructions.

12. Ram air intake lip ice boot – Check security and condition.

13. Right nose avionics compartment access door – Secured.

14. Drift sight window – Check condition and clean.

15. Battery compartment access panel – Secured (top and bottom).

(8) Right engine and propeller.

1. Accessory section exhaust vent – Check free of obstructions.

2. Left cowl locks – Locked.

3. Left exhaust stub – Check free of obstructions.

* 4. Propeller blades and spinner – Check blades for nicks, security of spinner and free rotation.

* 5. Nacelle air intake – Check free of obstructions.

6. Nacelle lip ice boot – Check condition and security.

* 7. Oil cooler air intake – Check free of obstructions and leakage.

8. Right cowl locks – Locked.

9. Right exhaust stub – Check free of obstructions.

* 10. Engine compartment – Check for fuel and oil leaks, oil level, positively secure oil cap (latch tab aft).

* 11. Nacelle tank fuel and cap – Check fuel level visually. Check seal is installed, cap is tight and properly installed (latch tab aft).

(O) 12. Fuel filter drain ring – Pull/release. Check for fuel drainage.

* 13. Engine compartment access door – Locked. Visually check locking hooks.

(O) 14. Engine wash access door – Locked.

(9) Right main landing gear.

* 1. Tire – Check for cuts, bruises, wear, and proper inflation.

2. Brake assembly – Check brake lines for damage or signs of leakage, and brake linings for wear.

* 3. Shock strut – Check for signs of leakage and a **2.75 INCH EXTENSION (MINIMUM).**

4. Torque knee – Check.

5. Safety switch – Check.

6. Wheel well general condition – Check.

* 7. Doors and linkage – Check.

8. Air bypass and oil cooler (rear) – Check free of obstructions and oil leaks.

*(O) 9. Firewall fuel filter drain (at inertial separator duct) – Turn/release. Check for fuel drainage.

(10) Right wing.

1. Inverter air intake screen and exhaust port – Check free of obstructions.

(O) 2. Antennas – Check for security and cracks at mounting points (top and bottom of wing).

3. Fuel vents (2) – Check heated and recessed vents free of obstructions.

4. Wing ice light – Check.

5. Deicer boot – Check bonding secure, boot free of cuts and cracks.

* 6. Wing tank fuel and cap – Check fuel level visually. Check seal is installed, cap is tight and properly installed (latch tab aft).

7. Fuel vent (1) – Check flush vent free of obstructions.

* 8. Tiedown – Released.

9. Landing light – Check.

(O) 10. Antennas – Check for security, HF loading disc for cracks and damage to underside.

(O) 11. Wing tip and navigation light – Check.

(O) 12. Wing antenna pod – Check for cracks and dents.

(O) 13. Wing pod navigation lights (2) – Check.

14. Static wicks – Check for security of discharge wicks.

15. Controls, flaps and trim tabs – Check hinge attachment and trim tab rig.

16. Skin condition – Check for skin damage, such as buckling, cracking, splitting, distortion, dents, or fuel leaks.

(O) 17. Chaff dispenser – Check number of chaffs in payload module and for security.

*(O) 18. Flare/chaff safety pin – Remove.

(11) Fuselage right side.

1. Skin condition – Check for skin damage, such as buckling, cracking, splitting, distortion or dents.

(O) 2. Flare/chaff test connection cap – Secure.

(O) 3. Flare dispenser – Check number of flares in payload module, and for security.

4. Air scoops – Check.

5. Cabin air exhaust vents – Check free of obstructions.

* 6. Antennas – Check for security.

7. Static port – Check free of dirt or obstructions.

* 8. Tiedown – Released.

(O) * 9. Tail stand – Removed.

(12) Empennage.

1. Right horizontal stabilizer deicer boots – Check bonding secure, boots free of cuts and cracks.

2. Right horizontal stabilizer – Check for security, cracks and skin condition.

(O) 3. VHF dipole antenna – Check security.

4. Static wicks – Check for security of discharge wicks.

5. Right elevator and trim tab – Check security and condition.

6. Navigation and beacon lights – Check condition.

7. Rudder and trim tab – Check security and condition.

8. Vertical stabilizer – Check skin condition.

9. Left elevator and trim tab – Check security and condition.

10. Static wicks – Check for security of discharge wicks.

11. Left horizontal stabilizer – Check for security, cracks and skin condition.

(O) 12. VHF dipole antenna – Check for security.

13. Left horizontal stabilizer deicer boot – Check bonding secure, boot free of cuts and cracks.

14. Vertical stabilizer deicer boot – Check bonding secure, boot free of cuts and cracks.

(13) Fuselage left side.

1. Static port – Check for freedom from dirt or obstructions.

2. Cabin air exhaust vent – Check free of obstructions.

(O) 3. INS air intake screen and exhaust ports – Check free of obstructions.

4. Skin condition – Check for skin damage, such as buckling, cracking, splitting, distortion or dents.

5. Main entrance and cargo doors – Check.

6. Chocks – Removed.

c. *Interior Check.*

1. Ladder – Stowed.

(O) 2. Cargo/loose equipment – Secured.

* 3. Cargo door – LOCK.

* 4. Main entrance door – LOCK.

5. Cabin emergency exit hatch – Secured (safety seal intact).

6. INS interface box circuit breakers – Check.

(O) 7. Flare/chaff dispenser preflight test – Completed.

(O) 8. Flare/chaff dispenser re-arm test – Conducted (prior to each rearming of a dispenser).

* ★ 9. Crew/passenger briefing – As required (Section VI).

8-12. Before Starting Engines.

* 1. Seats, pedals, belts, harness – Adjust.

2. Cockpit emergency entrance/exit hatch – Secured (safety seal intact).

3. Overhead control panel switches – Set.

4. Magnetic compass – Check for fluid, heading, and correction card.

5. Free air temperature – Note current reading.

6. Fire detection test switch – OFF.

CAUTION

Movement of the power levers to the full forward position, with the condition levers in the FUEL CUT-OFF position, may result in bending and possible damage to common linkage.

* 7. Power levers – IDLE.

CAUTION

Do not position the power levers into the REVERSE range while the engines are shut down. Damage to the reversing linkage will result.

* 8. Propeller levers – HIGH RPM.

* 9. Condition levers – FUEL CUTOFF.

10. Flaps – UP.

11. Control pedestal radios – OFF.

(O) 12. Flare/chaff dispenser control panel – Set number of flares/chaffs in payload modules.

(O) 13. Audio mission switches – VHF.

14. Landing gear emergency clutch disengage lever – Stowed.

15. Landing gear emergency extension handle – Stowed.

16. Fuel system circuit breakers – Check in.

17. Boost pumps – OFF.

18. Transfer pumps – OFF.

19. Crossfeed – CLOSED.

20. Pilot's audio control panel – Set (volume as required).

21. Marker beacon/glideslope receiver VOL control – OFF.

22. Pilot's flight instruments – Check for correct readings.

(O) 23. ADF/UHF DF switch – ADF position.

(O) 24. TACAN/INS switch – As required.

(O) 25. MD-1/INS switch – As required.

26. Compass slave MAG/DG switch – As required.

(O) 27. TACAN norm/auto switch – As required.

28. Pilot's course indicator switch – As required.

* 29. Engine instruments – Check readings, placards, and slippage marks.

(O) 30. RHAW – As required.

31. Instrument panel radios and radar equipment – OFF.

32. INS mode switch – As required.

33. Copilot's course indicator switch – As required.

(O) 34. TAC/INS switch – As required.

35. Copilot's flight instruments – Check for correct readings.

36. Emergency static air source – NORM OFF. Check for finger tight.

37. Copilot's audio control panel – Set.

38. Copilot's circuit breaker and fuse panel – Check in.

39. Right subpanel circuit breakers – Check in.

40. Vent blower – OFF.

41. Heater – OFF.

42. Gear handle – DOWN.

43. Left subpanel light switches (4) – OFF.

(O) 44. Windshield anti-ice switches – OFF.

45. Deice cycle switch – centered (off).

46. Autofeather system – OFF.

47. Heat switches (8) – OFF.

48. BUS ISO switch – Down (off).

(O) 49. Engine wash – OFF.

(O) 50. AC external power switch – OFF.

51. Landing lights – OFF.

52. Engine ice vanes – As required.

53. Ignition/start switches (2) – STOP.

(O) 54. Engine autoignition – OFF.

55. Inertial inverter – OFF.

56. Main inverter – OFF.

57. Mission equipment – OFF. Verify with mission operators.

(O) 58. Mission equipment power switch – As required.

(O) 59. Mission avionics DC power switch – As required.

* 60. DC GPU – Connect as required.

* 61. Battery – ON.

* 62. Voltage – Check (28 VDC maximum).

(O) 63. Battery fault reset light – Press to test.

* 64. Annunciator panel – Test.

NOTE

While FAULT WARN light is flashing, the DIM control is inoperative and all annunciator lights are at maximum brilliance.

*(N)65. Navigation lights – ON.

* 66. Landing gear handle lights – Test.

* 67. Landing gear down indicator lights (3) – Illuminated.

68. Keylock switch – On.

* 69. Fire detection system – Test. Verify warning horn sounds; simultaneously the red FAULT WARN light flashes and LH and RH FIRE WARNING lights illuminate in each numbered fire detection system test switch positions (3).

NOTE

A ground test of the engine fire detection system, insures electrical continuity within the system.

70. Fault warning button – Press. FAULT WARN light should extinguish.

* 71. Generators – OFF.

8-13. * INS Alignment – Before Engine Start.

CAUTION

Ground operation of inverters, with aircraft engines shut down, is limited to 30 minutes unless the inverter access/cooling doors on the upper wing are removed.

1. Main inverter switch – STBY. Check MAIN INV OUT light is extinguished, return switch to OFF.

2. Main inverter switch – MAIN. Check MAIN INV OUT light is extinguished, return switch to ON.

NOTE

When selected, the INERTIAL INVERTER will operate only if the INS mode switch is in the NAV position and a time delay of approximately 7 seconds has elapsed.

3. Inertial inverter switch – STBY. Check STBY INV OUT light is extinguished, return switch to OFF.

4. Inertial inverter switch – INERTIAL. Check INS INV OUT light extinguished, return switch to ON.

NOTE

For normal flight operations, using the INS system, the MAIN INVERTER should always be used to supply aircraft single-phase requirements. The automatic phase-switching circuit for the STBY INVERTER gives preference to single-phase requirements. Should a fault condition shut off the INERTIAL INVERTER, while the STBY INVERTER is operating in single-phase mode, INS system operation will terminate due to 3-phase power starvation. Even if 3-phase power is restored to the INS system, alignment will be lost.

5. INS – Align, refer to alignment procedure described in Chapter 3.

6. BUS ISO switch – BUS ISO.

8-14. * Starting Engines (Battery/GPU).

Starting procedure is identical for both engines. When making a battery start, start the right engine first (starting circuit is shorter).

CAUTION

Monitor ITT to avoid a hot start. If there is a rapid rise in ITT, be prepared to abort the start before limits are exceeded. During engine start, the maximum allowable ITT is 1090°C for two seconds. If this limit is exceeded, use ABORT START procedure and record the peak temperature and duration on DA Form 2408-13.

CAUTION

If ignition does not occur within 10 seconds after moving the condition lever to LO IDLE, initiate ENGINE CLEARING procedure. If for any reason a starting attempt is discontinued, the entire sequence must be repeated after allowing the engine to come to a complete stop.

CAUTION

If the N_1 tachometer immediately indicates above 20%, discontinue the start.

CAUTION

For RU-21A aircraft, do not exceed starter limitation of 40 seconds on, and 60 seconds off for two starter operations; then 40 seconds on, 30 minutes off.

CAUTION

For RU-21D aircraft, observe starter limits of 2 minutes on, 3 minutes off, 2 minutes on, 30 minutes off.

CAUTION

RU-21D engine start is restricted to the use of a GPU due to heavy current drain of the larger starter generators.

a. *Start Procedure.*

1. Rotating beacons – ON.

(N) 2. Navigation lights – ON.

3. Boost pumps (2) – ON. Check both BOOST FAIL lights extiguished.

4. Propeller – Clear (fig. 8-2, Exhaust Danger Area).

5. Ignition/start switch - ON (Check IGN ON light illuminated).

6. Condition lever – LO IDLE **(AFTER N_1 STABILIZES AT OR ABOVE 12% FOR 5 SECONDS).**

7. ITT – Monitor **(1090°C MAXIMUM** for engine being started. **750°C MAXIMUM** for operating engine).

8. Ignition/start switch – STOP (after ITT has stabilized, IGN ON light extinguished).

9. Condition lever – As required. HIGH IDLE (first engine battery start only). LOW IDLE for second engine start.

10. Generator (for battery start) – ON or RESET, then ON as required. GEN light extinguished.

11. Main inverter – STBY.

12. Fuel pressure – Check **(15 PSI MINIMUM).**

13. Oil pressure – Check **(40 PSI MINIMUM).**

14. Main inverter – Off.

15. Right propeller – FEATHER to disconnect GPU.

16. Right propeller – HIGH RPM.

17. Loadmeter – Monitor **(0.5 MAXIMUM).**

18. Second engine – Start, (4) through (16) above.

19. Fuel control heat switches (2) – ON.

20. Bus ISO – OFF (as required).

21. Main inverters – MAIN INVERTER.

22. Inertial inverter – INERTIAL.

23. INS – STBY (as required).

b. *Abort start.*

1. Condition lever – FUEL CUTOFF.

2. Ignition/start switch – STARTER ONLY.

3. ITT – Monitor for drop in temperature.

4. Ignition/start switch – STOP.

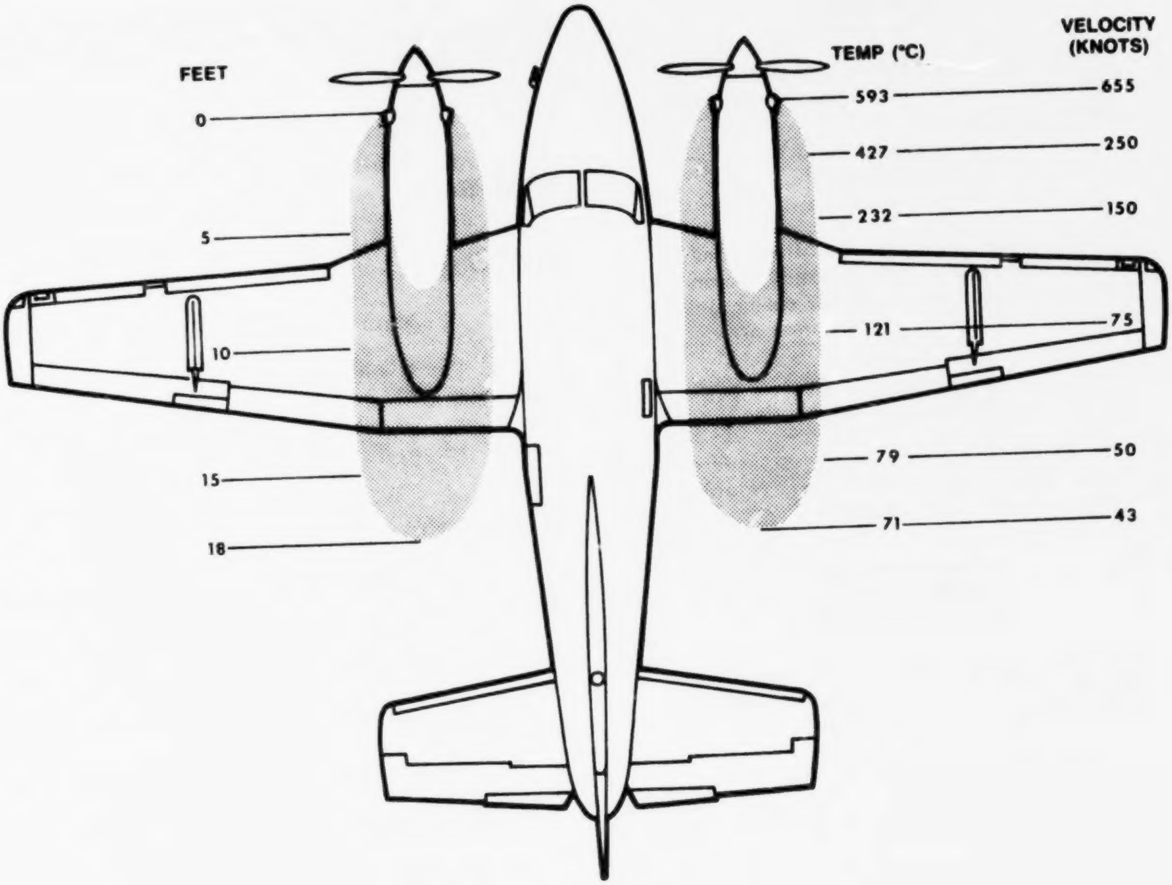
c. *Engine clearing.*

1. Condition lever – FUEL CUTOFF.

2. Ignition/start switch – STOP (allow 30 seconds delay after engine run-down).

3. Ignition/start switch – STARTER ONLY (for 30 to 40 seconds).

4. Ignition/start switch – STOP.



▨ EXHAUST DANGER AREA
(MAX POWER, STATIC CONDITION)

NOTE

THE EXHAUST DANGER AREA DOES NOT INCLUDE PROPELLER WAKE WHICH INCREASES VELOCITY, AND SIGNIFICANTLY REDUCES TEMPERATURE.

EXHAUST GAS TEMPERATURE AND VELOCITY AT GROUND IDLE IS VERY LOW. HOWEVER, THE IMMEDIATE AREA OF EXHAUST DISCHARGE SHOULD BE AVOIDED.

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Figure 8-2. Exhaust Danger Area

*8-15. Before Taxiing.

(O) 1. Radios – ON. Communication and navigation radios ON, radar and transponder STBY, radar signal detecting set ON, radar warning receiver ON.

(O) 2. Mission equipment power switch – On (up).

★ 3. Oxygen system – Check as required.

(1) Oxygen supply pressure gages (left cockpit sidewall) – Check.

(2) Oxygen supply pressure gage (regulator control panel) – **300 TO 400 PSI.**

(3) Supply control lever (green) – ON.

(4) Diluter control lever (white) – 100% OXYGEN.

(5) Emergency pressure control lever (red) – NORMAL.

(6) Oxygen mask hose – Connect to mask hose connection.

(7) Emergency pressure control lever (red) – Set to TEST MASK position while holding mask directly away from your face, then return lever to NORMAL.

(8) Oxygen mask – Put on and adjust to face.

(9) Emergency pressure control lever (red) – Set to TEST MASK position and check mask for leaks, then return lever to NORMAL.

(10) Flow indicator – Check (during inhalation blinker appears, during exhalation blinker disappears). Repeat a minimum of 3 times.

★(I) 4. Windshield anti-ice operation – Check. The electrothermal windshield will prevent initial ice adhesion to the glass, but will not remove ice already formed on the windshield. Therefore, anti-icing switches must be placed ON before entering icing conditions. When glass temperature exceeds 43°C, operational checks of the electrothermal windshields will be unreliable.

(1) Pilot's windshield anti-ice switch – ON (watch volt-loadmeter for a slight increase).

(2) Copilot's anti-ice switch – ON (confirm additional meter loads).

(3) Reposition switches as required for flight.

NOTE

The magnetic compass is erratic when the windshield anti-ice system is on.

5. Radios – Check intercom, communciation and navigation systems, radar and all mission operator positions.

★(O) 6. Autopilot system – Check as follows:

(1) Aircraft and autopilot controls – CENTER.

(2) Autopilot engage switch – ON. (Accomplish per Chapter 3, Section III.)

(3) Move turn control to the left (L), then to the right (R) – Check that aircraft control wheel follows movement.

NOTE

Intermediate positions of the control wheel are hard to obtain since there is no balance signal from the servos or control surfaces when the aircraft is not in flight.

(4) Rotate pitch trim control wheel forward (down) – Check that control column and trim tab control wheel follows movement.

(5) Autopilot altitude switch – Press ON. Check switch remains ON.

(6) Rotate the pitch trim control wheel – Check altitude switch goes OFF.

(7) ILS frequency – Set.

(8) Pilot's course indicator switch – VOR.

(9) ILS/VOR switch – ON.

(10) Control wheel and course deviation indicator on the same side – Check.

(11) Move the turn control out of detent – Check ILS/VOR switch is OFF.

(12) Autopilot engage switch (pilot's control wheel) – OFF, check autopilot is disengaged.

7. Taxi clearance – Check.

8. Clock – Set.

9. Altimeter – Set.

10. Parking brake – Release.

8-16. *Taxiing.

CAUTION

For RU-21D aircraft, extreme care should be exercised during taxi due to the close proximity of HF dipole antennas to the surface.

1. Brakes – Check.

2. Flight instruments – Check settings and operation.

3. Mission equipment checklist – Initiate.

8-17. Engine Runup.

Turn the aircraft into the wind if possible, and perform the following checks:

* 1. Nosewheel – center.

NOTE

The nosewheel cannot be straightened with rudder pedals when the aircraft is stopped.

* 2. Parking brake – Set (keep feet on rudder pedals).

NOTE

Parking brake can be set from pilot's seat only.

3. INS – As required. Refer to alignment procedure described in Chapter 3, if INS is not aligned prior to engine start.

* 4. Power levers – IDLE.

* 5. Condition levers – LO IDLE.

*★ 6. Manual crossfeed – Check by setting switch to OPEN. Check FUEL CROSSFEED light illuminates, then set switch to AUTO. Check FUEL CROSSFEED light is extinguished.

★ 7. Fuel system crossfeed operation – Check as follows:

(1) Crossfeed switch – AUTO.

(2) Left hand boost pump – OFF.

(3) Annunciator panel – Monitor. Left-hand boost pump fail light and fuel crossfeed lights must come on.

(4) Fuel pressure – Check (both engines).

(5) Left hand boost pump – ON.

(6) Crossfeed – CLOSED.

(7) Crossfeed – AUTO.

(8) Repeat procedure for right hand boost pump.

NOTE

Whenever the FUEL CROSSFEED light illuminates due to the start of automatic crossfeed, the light will not extinguish until the crossfeed switch is reset to CLOSED. Afterwards, the switch may be reset to AUTO and the light will remain extinguished.

* ★ 8. Fuel transfer pumps – Check as follows:

(1) Transfer test switch – Hold to R.

(2) Right transfer pump switch (while watching annunciator panel) – ON.

(3) Right no fuel transfer light – Check for momentary flash.

NOTE

Steady illumination, or lack of momentary flash, indicates a transfer pump system fault. For system fault recheck, switch transfer pump OFF for 5-10 seconds and repeat fuel transfer pump check. The momentary flash may not be detected if the cockpit lights are on.

(4) Repeat check procedure for left transfer pump system.

9. Flaps – Check operation of 4 panels and flap position indicator.

CAUTION

Avoid sustained ground operations above 60% power with the propeller(s) in feather. Possible heat damage to painted surfaces and higher oil temperature may occur.

10. Propeller manual feathering – Check by pulling propeller levers aft through detent to FEATHER. Check that propeller will feather, then advance lever to HIGH RPM.

*★ 11. Engine autoignition system – Check.

(1) Power Levers – Advance to **ABOVE 450 FT-LB TORQUE.**

(2) Autoignition – ARM (check green IGNITION ARM lights illuminated).

(3) Power levers – Retard to **LESS THAN 350 FT-LB TORQUE** (annunciator L and R IGN ON lights illuminated, green IGNITION ARM lights extinguished).

(4) Autoignition – OFF.

(5) Power levers – IDLE.

★ 12. Propeller autofeather system – Check.

(1) Power levers – IDLE.

(2) Autofeather test switch – TEST. Check AUTOFEATHER lights do not illuminate, and propellers do not feather. If switch is held in TEST position propellers will gradually feather.

(3) Power levers – **ADVANCE TO 500 FT LB TORQUE.**

(4) Autofeather test switch – TEST. Hold to test position and check both AUTOFEATHER lights illuminated; retard one power lever. **AT 350 to 450 FT-LB TORQUE,** check opposite AUTOFEATHER light extinguished. **At 150 to 290 FT-LB TORQUE,** check both AUTOFEATHER lights extinguished; check propeller starts to feather.

NOTE

AT 150 to 290 FT-LBS torque setting, AUTOFEATHER light may flicker.

(5) Power lever – Return to **500 FT-LB TORQUE.**

(6) Repeat steps 4 and 5 using the other power lever.

(7) Propeller autofeather switch – ARM.

(8) Both power levers – Advance to **88% to 92% MINIMUM N_1** (observe ITT and torque limits). Check both AUTOFEATHER lights illuminated. Retard each power lever individually below **88% to 92% N_1**. Check both AUTOFEATHER lights extinguished.

NOTE

If the aircraft is to be flown with a defective autofeather system, the PROP FEATHER circuit breaker should be pulled and the autofeather switch positioned to OFF.

★ 13. Overspeed governor – Check by setting RPM to 2100. Hold PROP GOV TEST switches UP. RPM should **DECREASE TO 1080 TO 2060.** Release test switches. RPM should return to 2100.

CAUTION

Do not exceed ITT or torque limits.

14. Engine ice vanes (left and right) – PULL TO EXT. Check operation by observing drop in torque reading, verify that handle remains extended when released, then push to RET.

NOTE

Loosen friction knobs prior to primary governor and secondary idle stop check to provide better feel.

★ 15. Primary governor – Check. Set 1900 RPM with power levers. Retard propeller levers to detent position. **CHECK FOR 1725 to 1755 RPM** then advance propeller levers to HIGH RPM.

CAUTION

To prevent damage to reversing linkage, do not force power levers to full REVERSE with test switch ON.

*★ 16. Secondary idle stop – Check. Check with condition levers in HIGH IDLE and power levers at IDLE, then while holding the secondary idle stop test switches down, move power levers slowly toward REVERSE, in one continuous movement, while observing that the SECONDARY LOW PITCH STOP lights illuminate and an **RPM RISE OF 170 TO 250** is obtained. Release the test switch and RPM should increase. Return power levers to normal idle position and cancel lights in annunciator panel by actuating secondary flight idle test switch if they remain illuminated.

17. Instrument suction – Check **(4.3 TO 5.9 IN. Hg.)**.

18. Pneumatic pressure – Check **(12 TO 20 PSI)**.

19. Volt loadmeters – Check bus voltage **BETWEEN 26.5 AND 29.5 VOLTS**, and load paralleling within one increment and a **MAXIMUM OF .5** on the loadmeter scale. Note any discrepancy on DA Form 2408-13.

(I) 20. Propeller deice system – Check. Move the switch to PROP position and check propeller ammeter normal operation **(14-18 AMPERES) FOR 2.5 MINUTES.** Flickering of the propeller deicing ammeter needle may or may not be detectable during cycle switching. Flickering of the propeller deicing ammeter needle may or may not be detectable during cycle switching.

(I) 21. Surface deice system – Check by activating deicer switch to SINGLE and visually check inflation and deflation of boots and pneumatic pressure. Repeat procedure for MANUAL switch position.

NOTE

The deicing system should be actuated on a daily basis to insure system function and to exercise the system distributor valve.

★ 22. Health indicator test (HIT) – As required.

NOTE

The HIT provides a go-no-go condition check prior to takeoff. HIT is performed at the completion of the engine runup check, when both engines are warmed and instruments stabilized. Test one engine at a time. Adjust engine N_1% to the N_1% value shown in the ITT log (fig. 8-3) for a FAT value which most closely matches the FAT on the free air temperature gage. After comparing indicator-read ITT with the proper log-given baseline ITT, the difference number is recorded in the log space provided. Appropriate actions depend upon the size of the difference number.

(1) Face aircraft into wind and insure that deice system is OFF.

(2) Set both engines at LO IDLE.

(3) Read free air temperature.

(4) Enter log FAT line at value nearest to free air temperature.

(5) Adjust engine N_1% to value shown in log N_1% line.

(6) Adjust speed of engine in check to 1900 RPM and stabilize instruments (minimum 30 seconds).

(7) Read ITT from indicator.

(8) Compare indicator ITT with log value shown in line labeled "Baseline ITT".

(9) Record aircraft or engine hours and difference (±) between indicated ITT and Baseline ITT in log section provided.

(10) If the ITT difference is 20°C or greater, perform the following actions:

(a) 20°C to 29°C, aircraft may be flown, but an entry shall be made on DA Form 2408-13.

(b) 30°C or greater, aircraft shall not be flown until the cause of excessive ITT is determined. An entry shall be made on DA Form 2408-13.

ACFT S/N

HIT ITT LOG

ENGINE NO.__________
ENGINE S/N

FAT °C	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2	0	-2	-4
N1%	95.5	95.2	94.9	94.5	94.2	93.9	93.6	93.3	93.0	92.7	92.4	92.1	91.7	91.4	91.0	90.7	90.4	90.1	89.9	89.6	89.3	89.0	88.7	88.3	88.0	87.7	87.4	87.0
BASELINE ITT																												

FAT °C	-6	-8	-10	-12	-14	-16	-18	-20	-22	-24	-26	-28	-30	-32	-34	-36	-38	-40	-42	-44	-46	-48	-50	-52	-54	-56	-58	-60
N1%	86.7	86.3	86.0	85.7	85.4	85.0	84.7	84.4	84.0	83.7	83.4	83.0	82.7	82.3	82.0	81.6	81.3	81.0	80.6	80.3	79.9	79.6	79.2	78.8	78.5	78.1	77.8	77.7
BASELINE ITT																												

ACFT OR ENG HRS (-13)	DIFF. FROM BASE LINE ITT (+)	ACFT OR ENG HRS (-13)	DIFF. FROM BASE LINE ITT (+)	ACFT OR ENG HRS (-13)	DIFF. FROM BASE LINE ITT (+)	ACFT OR ENG HRS (-13)	DIFF. FROM BASE LINE ITT (+)	ACFT OR ENG HRS (-13)	DIFF. FROM BASE LINE ITT (+)

AP 000778

Figure 8-3. HIT ITT Log

*8-18. Before Takeoff.

1. Mission equipment – Check equipment stowed. Check with each mission operator.

2. Fuel panel – Check switches and circuit breakers set.

3. Annunciator panel – Check (lights extinguished).

4. Engine and flight instruments – Check.

5. Propeller levers – Check HIGH RPM (full forward).

6. Friction locks – Set.

7. Flaps – As required.

8. Trim – Set.

9. Engine ice vanes – As required.

10. Fuel control heat – Check ON.

11. Autofeather switch – Check ARM.

(I) 12. Navigation radios – Set.

(O) 13. INS destination – Set.

14. Flight controls – Check for full travel and proper response.

15. Mirror – Retracted.

16. Windows and doors – Secure.

(I) 17. Anti-icing/deicing/pitot heat – As required.

18. Crew/mission operators – Ready for takeoff.

19. INS – Insert time (monitor thumbwheel 7).

*8-19. Line Up.

1. Transponder – As required.

NOTE

To prevent zeroizing the MODE 4 function of the AN/APX-72 transponder, when the landing gear is down (struts compressed) and either transponder or aircraft power is to be turned off, place the CODE switch momentarily in HOLD position.

2. GYRO/INS heading – Check.

NOTE

Prior to flight, the gyro magnetic compass indicator should be crosschecked with the magnetic compass to verify approximate heading as the indicator annunciator window will also be clear (blank) if the heading is 180° out of phase.

3. Power – Stabilized (70-80% N_1).

NOTE

AUTOFEATHER system arm lights should illuminate at 88% to 92% N_1. This is to assure autofeather arming at takeoff torque.

4. Autoignition – As required.

5. Landing/taxi lights – As required.

8-20. Takeoff.

WARNING

Minimum run takeoff is a contingency maneuver and may be performed below Vmc and below power off stall speed. Control of the aircraft may be lost if engine failure occurs at or immediately following liftoff or until the best angle of climb speed can be obtained.

CAUTION

To prevent damage to the landing gear retraction mechanism, brakes should not be applied to slow down the rotation of the tires while retracting the landing gear or after gear is up. A rubberized drag brake shoe is provided in the wheel well to stop the wheels from rotating after retraction.

CAUTION

On RU-21D aircraft, bank angles in excess of 4 degrees during takeoff roll or immediately after takeoff, will result in HF dipole antennas contacting the surface.

To aid in planning the takeoff and to obtain maximum aircraft performance, refer to chapter 7.

a. Normal Takeoff. Apply takeoff power. Maintain directional control with nosewheel steering and rudder while maintaining wings level with ailerons. Use of differential power at the beginning of takeoff roll will assist in directional control. Rotate at V_r and allow the aircraft to accelerate to the desired climb airspeed. Rotation should be at a rate that will allow liftoff at the liftoff speed (V_{lof}).

b. Crosswind Takeoff. Position the aileron control into the wind at the start of the takeoff roll. Leading with upwind power at the beginning of the takeoff roll will assist in maintaining directional control.

c. Minimum Run Takeoff. Minimum run takeoffs are performed with APPROACH flaps. After the lineup check is completed set takeoff power and release brakes. As soon as elevator control becomes effective (approximately 50 KIAS) raise the nose wheel clear of the runway. Continue to apply elevator pressure in a smooth continuous motion until clear of the runway, then lower nose and accelerate to desired climb speed. Monitor ITT and torque. Retract the landing gear when flight is assured.

d. Obstacle Clearance Climb. When flight is assured, retract the landing gear and establish a wings-level climb attitude, maintaining the computed best angle-of-climb speed (V_x). Climb at this speed until clear of the obstacle. After the obstacle is cleared, accelerate to an airspeed equal to or exceeding best rate-of-climb airspeed (V_y). Retract flaps after attaining single-engine best rate-of-climb airspeed (V_{yse}).

8-21. After Takeoff.

CAUTION

Retract landing gear below 127 KIAS. Additional airspeed imposes excessive air loads on the gear retraction mechanism.

1. Gear – UP.

2. Flaps – UP.

3. Climb power – Set (1900-2200 RPM).

(O)★ 4. Autopilot engagement – As required.

5. Autofeather – OFF.

(O) 6. Mission power – ON.

7. Wings and nacelles – Check for fuel and oil leaks.

8. Landing/taxi lights – As required.

(O) 9. Flare/chaff dispenser safety pin (electronic module) – Remove.

(O) 10. Flare/chaff dispenser arm-safe switch – ARM.

(O) 11. Chaff function selector switch – As required.

8-22. Climb – Normal.

Refer to Chapter 7 for Normal climb speeds.

8-23. Climb – Max Rate.

Refer to Chapter 7 for maximum rate of climb speeds.

8-24. Cruise Checks.

Refer to Chapter 7 for the necessary flight planning information. Refer to Chapter 2 for necessary fuel system management. The following procedures are applicable to all cruise requirements:

CAUTION

Maximum turbulent air penetration speed is **168 KIAS**.

1. Power – Set (1800-2000 RPM). Do not exceed maximum cruise-torque settings in Chapter 7.

2. INS – As required.

3. Wings and nacelles – Check for fuel and oil leaks.

4. TACAN – AUTO or T/R.

8-25. Fuel System Crossfeed.

Refer to chapter 9 for fuel system crossfeed emergency procedures.

8-26. Descent.

a. Descent – Max Rate (Clean).

1. Power – IDLE.

2. Propellers – HIGH RPM.

3. Gear – UP.

4. Flaps – UP.

5. Airspeed – 208 KIAS maximum.

b. Descent – Max Angle (Landing Configuration).

1. Power – IDLE.

2. Propellers – HIGH RPM.

3. Flaps – APPROACH (173 KIAS).

4. Gear – DOWN (154 KIAS).

NOTE

To prevent zeroizing the MODE 4 function of the AN/APX-72 transponder, when the landing gear is down and either transponder or aircraft power is to be turned off, place the CODE switch momentarily in HOLD position.

5. Flaps – DOWN (130 KIAS).

6. Airspeed – 130 KIAS.

8-27. Descent-Arrival Check.

Perform the following checks prior to traffic pattern entry:

1. Seat belts and shoulder harness – Secure (passenger/mission operators checked). (Face operator's seats forward in RU-21A.)

2. Fuel panel – Check.

3. Parking brake handle – In.

4. Engine ice vanes – As required.

5. Mission power – OFF.

6. INS – As required.

(O) 7. Flare/chaff dispenser arm-safe switch – SAFE.

(O) 8. Flare/chaff dispenser safety pin (electronic module) – Insert.

8-28. Before Landing.

1. Autofeather – ARM.

2. Flaps – APPROACH (below 173 KIAS).

3. Gear – DN (below 154 KIAS). Check lights.

4. Landing lights – On.

NOTE

If the landing gear is down and locked, the gear position indicator lights on the control pedestal will illuminate green and internal red light in the handle will be extinguished. The warning horn will be silent when power is reduced.

8-29. Obstacle Clearance Approach.

Fly a normal traffic pattern completing the before landing checks as previously described. Lower flaps on base leg as required and complete final landing check after turning final. Adjust pitch, power and flaps to maintain the desired approach angle and airspeed so as to arrive at the intended landing point at minimum touchdown speed consistent with existing conditions.

8-30. Landing.

CAUTION

On RU-21D aircraft, banks in excess of 4 degrees during landing and landing roll will result in HF dipole antennas contacting the surface.

CAUTION

On RU-21D aircraft, due to HF dipole antenna clearance, landing on unprepared runways should only be considered in an emergency.

NOTE

100% flaps must be used to obtain the minimum landing distances in Chapter 7.

(O) 1. Autopilot – Disengage.

2. Gear – Recheck DN (check lights).

3. Propellers – As required (HIGH RPM, if beta or reverse is required).

NOTE

Propeller reverse below 40 knots will increase propeller blade erosion. Exercise caution when reversing on surfaces where loose sand, gravel, or dust are present.

a. Normal Landing. Refer to chapter 7 for landing data. Plan the final approach to arrive at runway threshold at recommended approach speed. As the aircraft touches down, gently lower the nosewheel to the runway and use reversing, brakes, or beta range, as required.

b. Crosswind Landing. Crab or slip into the wind to correct for drift during final approach. The crab is changed to a slip for roundout and touchdown. Differential power may be used to aid in aircraft control during approach and landing. Refer to chapter 7 for landing data.

c. Power Approach/Precision Landing. Set power, flaps, and trim as required to maintain the desired airspeed and descent angle.

d. Touch and Go Landing. If a touch and go landing is to be performed, allow the nose wheel to touch the runway and perform the following:

1. Flaps – As required.
2. Trim – Set.
3. Power – Maximum allowable.

8-31. Go-Around.

When a go-around is started before the LANDING check, use power as required to climb to, or maintain, desired altitude and airspeed. If the go-around is started after the LANDING check has been performed, apply maximum allowable power and simultaneously increase pitch attitude to stop the descent. Retract the landing gear after ensuring that the aircraft will not touch the ground. Retract the flaps to APPROACH, adjusting pitch attitude simultaneously to avoid altitude loss. Accelerate to best rate-of-climb airspeed (Vy), retracting flaps fully after attaining the Vref speed used for the approach and perform the following:

1. Power — As required.
2. Gear — Up.
3. Flaps — Up.

4. LANDING LIGHTS — OFF.

5. Climb Power — Set.

8-32. After Landing.

CAUTION

Prolonged use of landing lights on the ground may cause heat damage to the plastic landing light shield due to the lack of cooling airflow.

1. Landing/taxi lights - As required.

2. Propellers - HIGH RPM.

3. Flaps - UP.

4. Autoignition - OFF.

5. Anti-icing/deicing - OFF.

6. Engine ice vanes - As required.

7. Radar/transponder - Standby.

NOTE

To prevent zeroizing the MODE 4 function of the transponder, when the landing gear is down and the struts compressed, place the CODE control momentarily in HOLD position before either transponder or aircraft power is turned off. CODE HOLD condition will only be removed when the struts are extended and the MASTER control is not in OFF position.

(O) 8. Voice Security - Zeroize.

8-33. Engine Shutdown.

1. Parking brake - Set.

2. Landing/taxi lights - OFF.

3. Heater - OFF.

4. Vent blower - OFF.

5. Mission equipment - OFF. (Check with mission operators.)

(O) 6. Radios/radar/transponder - OFF and zerozied.

(O) 7. Radar signal detecting set and radar warning receiver - OFF.

8. Autofeather switches - OFF.

9. Heat switches (8) - OFF.

(O) 10. INS - Shut down. Refer to Chapter 3.

11. Inverters - OFF.

12. Propellers - FEATHER.

13. Conditon Levers - FUEL CUTOFF (ITT 610°C or less).

14. Boost pumps - OFF (below 10% N_1).

15. Transfer pumps - OFF.

16. Crossfeed - CLOSED.

17. Beacon/lighting systems - OFF.

18. Master switch - Down.

(O) 19. Oxygen regulator control levers - NORMAL, 100%, and OFF.

(O) 20. Oxygen console valve - OFF.

21. Keylock switch - OFF.

8-34. Before Leaving Aircraft.

1. Wheels - Chocked.

2. Parking brake - As required.

NOTE

Parking brakes are primarily intended for short term usage. Temperature changes or system leakage may cause inadvertent brake release.

3. Flight controls - Locked.

(O) 4. Classified material - Inventoried, inspected and removed.

(O) 5. Mission equipment – Zeroized and inspected.

(O) 6. Voice security computer – Removed.

(O) 7. Transponder computer – Removed.

(O) 8. Transponder – Check zeroized.

NOTE

In the event classified material or cryptographic security equipment must be left on board the aircraft due to lack of storage facilties, the pilot in command will insure the aircraft is guarded by appropriately cleared and armed personnel (Reference AR-380-40).

9. Windows and doors – As required.

(O) 10. Flare/chaff dispenser wing safety pin – Insert.

11. Walkaround inspection – Completed.

NOTE

If strong winds are anticipated while the aircraft is unattended, the propellers should be tied down to prevent windmilling with zero oil pressure.

12. DA Form 2408-12 and 13 – Completed.

NOTE

In addition to established requirements for reporting any system defects, unusual and excessive operation such as hard landings, etc., the flight crew will also make entries in DA Form 2408-13 to indicate when limits in the operator's manual have been exceeded.

13. Aircraft – Secure.

Section III. INSTRUMENT FLIGHT

8-35. General.

This aircraft is qualified for operation under instrument flight conditions. Flight handling, stability characteristics, and range are the same during instrument flight conditions as when under visual flight conditions. Adequate navigation and communciation equipment is installed to provide instrument flight.

NOTE

For proper instrument operation, allow approximately 5 minutes for instrument warmup time, prior to takeoff.

8-36. Instrument Flight Procedures.

Refer to FM 1-5, FM 1-30, FLIP, AR 95-1, FAR Part 91, and procedures described in this manual.

a. Instrument Takeoff. Complete the normal checks prescribed in this chapter. When ready for takeoff, align the aircraft with the center of the runway. Allow it to roll straight ahead for a few feet before stopping so the nosewheel will be straight. Hold the brakes and note the heading to be maintained during takeoff roll. Follow takeoff procedures dictated by local conditions.

NOTE

A slight amount of pitch error in the indication of the attitude indicator will result from accelerations or decelerations. It will appear as a slight climb indication after an acceleration and a slight dive indication after deceleration. The error will be most noticeable at the time the airplane breaks ground during takeoff. At this time, a climb indication error of approximately one-half of the bar width will normally be noticed; however, the exact amount of error will depend upon the acceleration and elapsed time of each individual takeoff. The erection system will automatically remove the error after the acceleration ceases.

b. Instrument Climb. Instrument climbs should normally be performed at 140 KIAS. Refer to Chapter 7 for information regarding fuel consumption and rate-of-climb. When safe altitude and climb air speed are attained, complete the after takeoff checks as prescribed in this chapter.

NOTE

Climb or cruise at 10 to 15 KIAS above normal speeds when icing conditions exist. Reducing the angle of attack minimizes the accumulation of ice on all surfaces.

c. Instrument Cruise. There are no unusual flight characteristics during cruise in instrument meteorological conditions.

d. Speed Range. Stability and flight characteristics are normal through the full speed range during instrument flight operations. Power settings during instrument flight should be conducted in accordance with the power charts in Chapter 7.

e. Communication and Navigation Equipment. No special technique due to aircraft configuration is required.

f. Instrument Descent. When a descent at slower than cruise speed is desired, slow the aircraft to the desired speed before initiating the descent. Normal descent or radar controlled descent to traffic pattern altitude can be made using cruise airspeed. Normally, descent will be made with the aircraft in a clean configuration, maintaining cruise speed by reducing power as required. The aircraft is completely controllable in a high rate of descent with the landing gear and wing flaps extended. A high rate of descent may be obtained using the drag on the propellers in HIGH RPM.

g. Holding. Recommended holding airspeed is 140 KIAS. Maintain cruise RPM and reduce power as required. For extended holding patterns, consult the appropriate fuel and power chart in Chapter 7. For descents in the holding pattern, decrease power and maintain the holding pattern airspeed.

h. Instrument Approaches. Various procedures can be used for instrument approaches. Whether letdowns are made in clean or in landing configuration are at the discretion of the pilot. Turbulence or action to be accomplished when the aircraft reaches the lower altitude will govern the type of letdown. When a low ceiling exists, do not extend flaps to full down (100%) until runway is in sight and landing is assured. If it is necessary to make an emergency instrument descent, the rate during the last 1000 feet prior to landing should be adjusted to less than 500 feet per minute.

8-37. Night Flying.

NOTE

> Autoignition shall be used during night operations above 14,000 feet.

Night flying is very closely related to instrument flying and may often be conducted almost entirely under instrument conditions. Before takeoff, it is imperative to insure that all lights, instruments, and avionic equipment are functioning properly. Generally, interior lighting should be kept to the minimum amount which will still allow complete visibility of all instruments and gages. Excessive cockpit lighting decreases outside visibility. Avoid using landing lights when in thick haze, smoke, or fog, as reflected light will reduce visibility and may affect depth perception. During ground operations, the aircraft should be taxied slowly. Once rolling it is difficult to judge actual ground speed and excessive speeds may be developed without realizing it.

Section IV. FLIGHT CHARACTERISTICS

8-38. Normal Flight Characteristics.

The flight characteristics of the aircraft are normal throughout its speed range.

8-39. Stalls.

Ample stall warning in the form of buffeting or mechanical stall warning, is given when a stall approaches. This buffet warning will occur at approximately 5 to 10 knots above stall speed with the aircraft in clean configuration. With full wing flaps, the buffet will occur almost simultaneously with the stall. If a forward loading condition exists, minimum control speed may be encountered rather than full stall. If correct stall recovery technique is used, very little altitude will be lost during the stall recovery. The terms "power-on" and "power-off" will be employed during discussion of specific stall situations. For the purpose of this section, the term "power-on" shall mean that both engines and propellers of the aircraft are operating normally, and are responsive to pilot control. The term "power-off" shall mean that both engines are operating at idle power.

a. *Power-On Stalls.*

(1) The power-on stall attitude is very steep. A light buffet precedes stalls, and the first indication of approaching stall is a decrease in control effectiveness, accompanied by a continuous tone from the stall warning horn (refer to Stall Warning System, Chapter 2). The stall itself is characterized by a rolling tendency if the aircraft is allowed to yaw. The proper use of rudder to prevent yaw will also prevent a tendency to roll. A pitching tendency will develop if the aircraft is held in the stall, resulting in the nose dropping sharply, then pitching to above the horizon; this cycle is repeated until recovery is made.

(2) Control is regained very quickly with little altitude loss, providing the nose is not lowered excessively. Begin recovery with forward movement of the control wheel and a gradual return to level flight. In normal power-on stalls, a steep climb attitude is required. Unless the attitude is maintained, the aircraft will generally "buffet" instead of stall. The roll tendency caused by yaw is more pronounced in power-on stalls, as is the pitching tendency; however, both are easily controlled after the initial entry. The roll can be prevented by proper rudder pressure. Power-on stall characteristics are not greatly affected by landing gear and wing flap position, except that stalling speed is reduced in proportion to the degree of wing flap extension.

b. *Power-Off Stalls.* The roll tendency is considerably less pronounced in power-off stalls (in either takeoff, landing, or clean configuration), and is more easily prevented or corrected by proper use of rudder and aileron. The nose will generally drop straight through, with some tendency to pitch up again if recovery is not made immediately. With wing flaps down, there is little or no roll tendency and stalling speed is 7 to 8 knots slower than with wing flaps up. The Stall Speed Charts (fig. 8-4, 8-5) show the indicated power-off stall speeds with landing gear and wing flaps UP or DOWN.

c. *Accelerated Stalls.* Accelerated stalls are caused by increasing the aircraft's weight due to centrifugal force in a turn or an abrupt pull-out

STALL SPEED

POWER OFF

STALL SPEED
RU-21A
T74-CP-700

WANTED

STALL SPEED

KNOWN

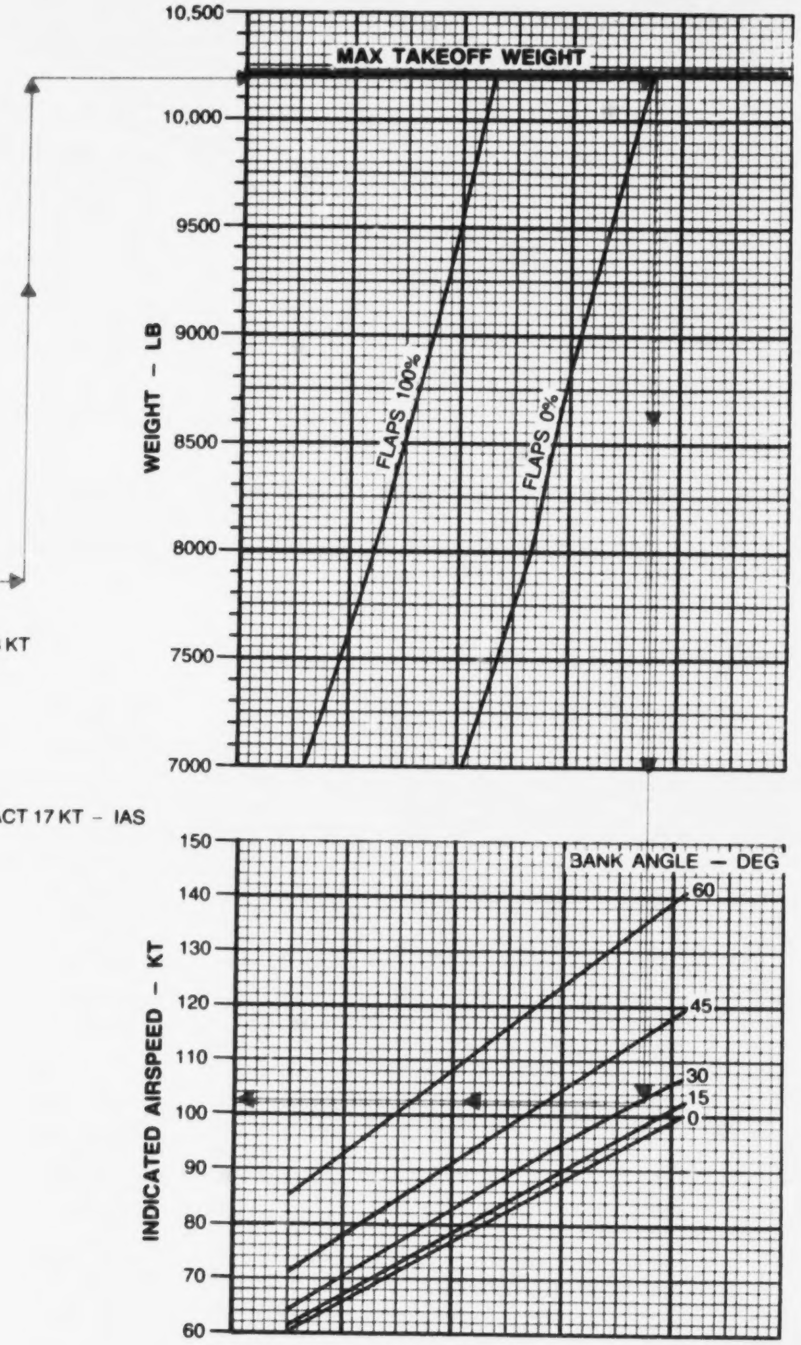
WEIGHT = 10,200 LB
FLAPS SETTING = 0%
BANK ANGLE = 30°

METHOD

ENTER WEIGHT HERE
MOVE RIGHT TO FLAP SETTING
MOVE DOWN TO BANK ANGLE
MOVE LEFT, READ STALL SPEED = 103 KT

NOTE

FOR POWER ON STALL SPEED, SUBTRACT 17 KT – IAS



DATA BASIS: DERIVED FROM FLIGHT TEST

Figure 8-4. Stall Speed RU-21A

STALL SPEED

POWER OFF

STALL SPEED
RU-21D
T74-CP-700

WANTED

STALL SPEED

KNOWN

WEIGHT = 9650 LB
FLAP SETTING = UP
BANK ANGLE = 30°

METHOD

ENTER WEIGHT HERE
MOVE RIGHT TO FLAP SETTING
MOVE DOWN TO BANK ANGLE, READ
STALL SPEED = 98 KT

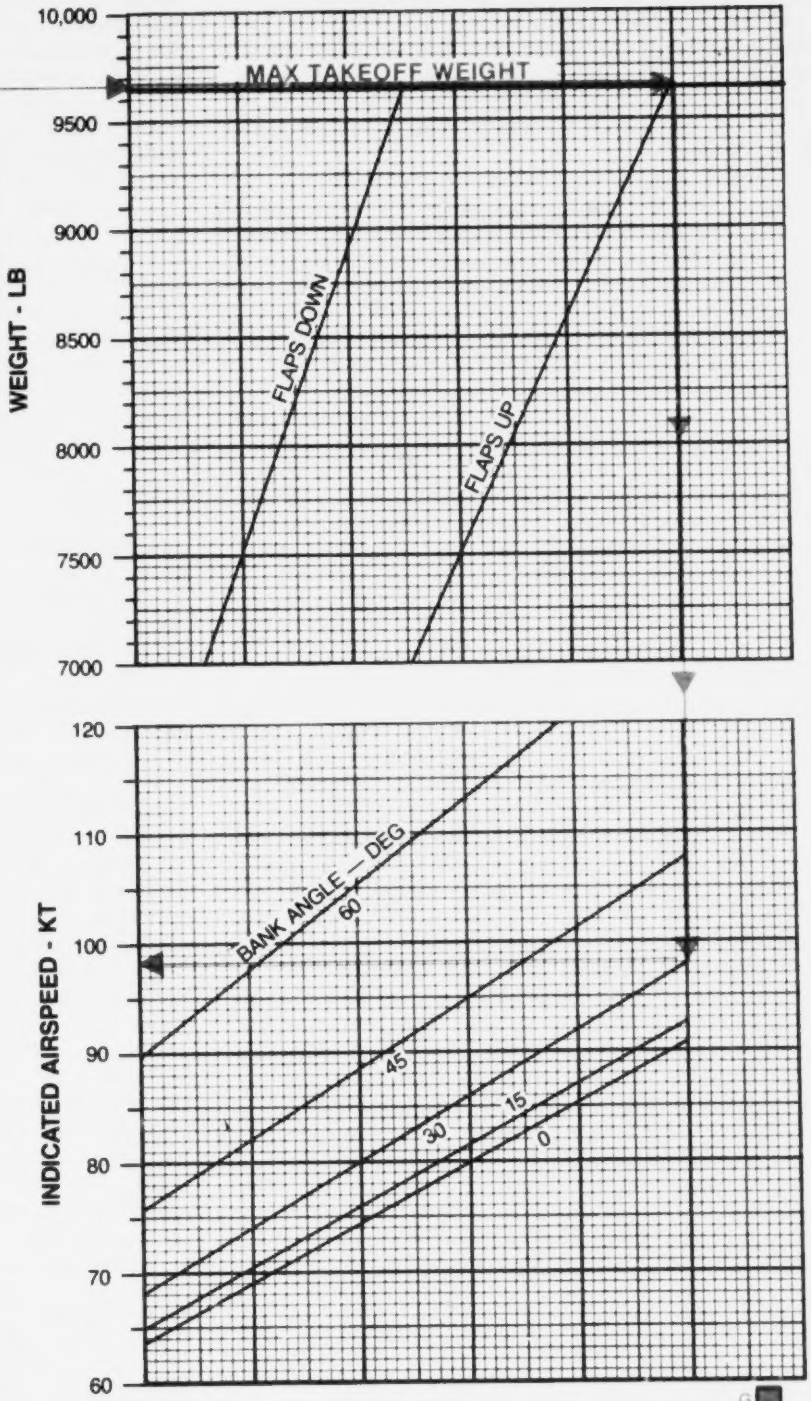


Figure 8-5. Stall Speed **RU-21D**

G
R
AP 001423

from a dive. The stall speed is increased by the square root of the G factor multiplied by the normal stalling speed. The aircraft gives noticeable stall warning in the form of buffeting when the stall occurs. The stall warning and buffet can be demonstrated in turns by applying excessive back pressure on the control wheel.

8-40. Spins.

CAUTION

Do not pull out of the resulting dive too abruptly as this could cause excessive wing loads and a possible secondary stall.

Intentional spins are not permitted. If a spin is inadvertently entered, use the following recovery procedures accomplishing steps 1 through 3 as near simultaneously as possible.

1. Power levers – IDLE.

2. Apply full rudder, opposite the direction of spin rotation.

3. Push control wheel full forward and neutralize ailerons.

4. Maintain control positions in Steps 1 through 3 until rotation stops then neutralize all controls and execute a smooth pullout.

NOTE

Spin tests have not been conducted on this aircraft. The recovery technique is based on the best available information.

8-41. Diving.

Maximum diving airspeed (red line) is 208 KIAS (208 KCAS, V_{mo}) as shown in the Flight Envelope Chart, Chapter 5. Flight characteristics are conventional throughout a dive maneuver, however, caution should be used if rough air is encountered after maximum allowable dive speed has been reached, since it is difficult to reduce speed in dive configuration. Dive recovery should be very gentle to avoid excessive aircraft stresses.

8-42. Maneuvering Flight.

The maximum speed at which abrupt full control travel may be applied without exceeding the designed load factor of the aircraft is 168 KIAS. The Flight Envelope Chart as shown in Chapter 5 is a plot of acceleration versus speed. This chart is prepared for maximum gross weight and shows the speeds at which maneuvers are restricted and unrestricted, as related to load limit factors.

8-43. Flight Controls.

The aircraft is stable under all normal flight conditions.

8-44. Level Flight Characteristics.

All flight characteristics are conventional through the level flight speed range.

8-45. Flat Turns (Less than 5° Bank).

When the mission requires turns without banking, a constant altitude, wings level attiude standard rate turn may be accomplished by the application of rudder pressure or rudder trim in the desired direction of turn. Hold wings level with opposite aileron and trim the elevator to maintain a constant altitude. Approximately 15 pounds force is required on the aileron control to maintain wings level. Flat turns in excess of 3 degrees per second can be accomplished. However, to enhance crew comfort, turns in excess of 3 degrees per second are not recommended. A turn radius of 2 miles is readily accomplished using the above procedure at an indicated airspeed of 105 - 120 knots. The radius of turn may be decreased by the use of asymmetrical power.

Section V. ADVERSE ENVIRONMENTAL CONDITIONS

8-46. Introduction.

The purpose of this section is to inform the pilot of the special precautions and procedures to be followed during the various weather conditions that may be encountered in flight. This section is primarily narrative; only those check lists that cover specific procedures characteristic of weather operations are included. The checklist in Section II provides for adverse environmental operation.

8-47. Cold Weather Operation.

Operating difficulties may be encountered during extremely cold weather, unless proper steps are taken prior to or immediately after flight. All official personnel should understand and be fully aware of the necessary procedures and precautions involved.

a. Preparation For Flight. Accumulations of snow, ice or frost on aircraft surfaces will adversely affect takeoff distance, climb performance and stall speeds to a dangerous degree. Such accumulations must be removed before flight. Refer to Chapter 2, Section XII. In addition to the normal exterior checks, following the removal of ice, snow or frost, inspect wing and empennage surfaces to verify that these remain sufficiently cleared. Also, move all control surfaces to confirm full freedom of movement. Check tires for proper inflation and assure that they are not frozen to wheel chocks or to the ground. Use ground heaters to free frozen tires. When heat is applied to release tires, the temperature of the heat should not exceed 160°F (71°C). In extreme emergencies, tires may be inflated to 1.5 times the normal pressure to break adhesions to ice, then restored to normal pressure. Use external power source for starting engines. Pre-heating of engine oil is unnecessary.

b. Engine Starting. Observe engine starter time limits. If there is no rise in engine oil pressure after 30 seconds or pressure drops below minimum (40 PSI), shut down the engine.

c. Warm-Up and Ground Test. Warm-up procedures and ground test will follow those outlined in Section II.

d. Taxiing Instructions. Avoid taxiing through slush and water if possible. Water and slush splashed on the wings, antennas and empennage may freeze, increasing weight and drag and possibly limit control surface movement. Wheels will be visually checked by the ground crew to insure they are turning.

e. Before Takeoff. Turn on the propeller electrothermal deicer system and all anti-icing systems, just prior to takeoff. Also accomplish the BEFORE TAKEOFF steps in Section II.

f. Takeoff. Takeoff procedures for cold weather operations are the same as for normal takeoff. Follow the procedures in Section II. Deep snow on the runway may cause enough drag to prevent takeoff. Light snow or ice will decrease the traction of the tires. Use of brakes and nose wheel steering may be ineffective.

g. During Flight. It may be advisable to cycle the landing gear a few times after takeoff to dislodge ice accumulated from spray of slush or water on runway. Trim tabs and controls should also be exercised periodically to prevent freezing. If visible moisture is inadvertently encountered, anti-icing systems should be activated.

h. Descent. Use normal procedures in Section II for descent.

NOTE

If icing conditions are encountered during approach a slightly higher-than-normal airspeed should be maintained in order to compensate for increased drag, additional weight, and higher than normal stall speeds.

i. Landing. Use procedures in Section II for normal landing.

NOTE

In order not to impair pilot visibility, reverse thrust should be used with caution when landing on a runway covered with snow or standing water.

j. Engine Shutdown. Follow the normal engine shutdown procedures in Section II.

k. Before Leaving the Aircraft. Park the aircraft in a warm area if possible. Should this be impossible; after wheel chocks are in place, release the brakes to prevent freezing and lock the control surfaces. Condensation will be minimized if aircraft fuel tanks are filled. Remove any accumulation of dirt and ice from the landing gear shock struts. Install protective covers to guard against possible collection of snow and ice.

8-48. Desert Operation.

Dust, sand and high temperatures encountered during desert operation can sharply reduce the operational life of the aircraft and its equipment. The abrasive qualities of dust and sand upon turbine blades and moving parts of the aircraft and the destructive effect of heat upon the aircraft instruments will increase maintenance if basic preventive measures are not followed. In flight, the hazards of dust and sand will be difficult to escape, since dust clouds over a desert may be found at altitudes up to 10,000 feet.

a. Preparation for Flight. Check the position of the aircraft in relation to other aircraft. Propeller blown sand blast can damage other aircraft. Wipe the landing gear shock struts free of dust and sand with a clean cloth. Remove all aircraft protective covers. Check instrument panel and general interior for dust and sand accumulation. Open main entrance door and cockpit vent/storm windows to ventilate the aircraft. Operate all moveable control surfaces.

b. Engine Starting. Perform the normal procedures in Section II.

c. Warm-Up Ground Tests. Perform the normal procedures in Section II. To minimize possibility of damage to the engine during desert operation, use inertial separators.

d. Taxiing. When practical avoid taxiing over sandy terrain. Propeller and engine deterioration may result from the impingement of sand and gravel. Use minimum wheel braking action since brake cooling is retarded at high ambient temperatures.

e. Takeoff. No special technique or procedures are required during takeoff.

f. Landing. No special technique or procedures are required during landing. (Refer to Section II for normal ENGINE SHUTDOWN procedures.)

g. Before Leaving the Aircraft. Install all protective covers to keep out blowing sand and dust. If blowing sand and dust do not present a hazard, leave the cockpit vent/storm windows open to provide ventilation. Take extreme care to prevent sand or dust from entering the fuel and oil systems during servicing.

8-49. Hot Weather Operation.

CAUTION

A limitation based on pressure altitude and ambient temperature prohibits aircaft takeoff under certain high ambient temperature conditions. (Takeoff Temperature Limitations Chart in Chapter 5.)

During hot weather operations, the principle difficulties encountered are high interstage turbine temperature (ITT) during engine starting and takeoff, over-heating of brakes, and longer takeoff and landing rolls. In areas where high humidity is encountered, electrical equipment (such as communication equipment and instruments) will be subject to malfunction by corrosion, fungi, and moisture absorption by nonmetallic materials.

a. Preparation for Flight. No special technique or procedures are required for flight preparation.

b. Engine Starting. Engine starting under conditions of high ambient temperatures may produce a higher than normal ITT during the start. The ITT should be closely monitored when the condition lever is moved to the LO IDLE position. If overtemperature tendencies are encountered, the condition lever should be moved to IDLE CUTOFF position periodically during acceleration of gas generator RPM (N_1). Be prepared to abort the start before temperature limitations are exceeded.

c. Warm-Up Ground Tests. Perform the normal procedures in Section II.

d. Taxiing. Use minimum wheel braking action since brake cooling is retarded at high ambient temperatures.

e. Takeoff. No special technique or procedures are required during takeoff.

f. During Flight. No special technique or procedures are required during normal operations.

g. Descent. No special technique or procedures are required during descent.

h. Landing. No special technique or procedures are required during landing.

i. Engine Shutdown. Refer to Section II for ENGINE SHUTDOWN procedure.

CAUTION

If fuel tanks are completely filled, fuel expansion may cause overflow, thereby creating a fire hazard.

j. Before Leaving the Aircraft. Install wheel chocks and release the wheel brakes to prevent warpage of the brake discs. Leave windows and doors open as necessary for ventilation.

8-50. Turbulent Air and Thunderstorms.

WARNING

Due to the comparatively light wing loading, control in severe turbulence and moderately heavy thunderstorms is critical. Since turbulence imposes heavy loads on the aircraft structure, make all necessary changes in aircraft attitude with the minimum amount of control pressures to avoid excessive loads on the aircraft's structure.

Plan the flight to avoid areas of severe turbulence and thunderstorms. During night or instrument flight conditions it is not always possible to detect individual storm areas or find the in-between clear areas. If such turbulence is to be penetrated, it will be necessary to counter rapid changes in attitude and accept major indicated altitude variation.

8-51. Penetration.

The maximum safe penetration speed in severe turbulence is **168 KIAS.** Pitch attitude and constant power settings are vital to proper flight technique. Establish recommended penetration speed and proper attitude prior to entering turbulent air. Maintaining a pre-established attitude will result in a fairly constant airspeed. Complete the following procedure when there is a possibility of encountering turbulent air due to thunderstorm activity:

1. Establish penetration airspeed.

2. Secure loose equipment.

3. No smoking.

4. Tighten seat belts and shoulder harnesses.

5. Turn cockpit and cabin lights on to minimize the blinding effect of lightning.

6. Turn on pitot heat and stall warning heat when visible moisture is encountered.

7. Check flight instruments for proper indication.

8. Advise crew members of approach to storm.

9. Maintain constant power setting and pitch attitude. Concentrate on maintaining a level attitude by reference to the attitude indicator.

NOTE

If possible, adjust to the desired power setting prior to entering a storm area. Generally, this power setting will be lower than that used for cruise operations.

10. Maintain original heading. Make no turns unless absolutely necessary.

11. Do not chase the airspeed indicator; doing so will only result in extreme variations of aircraft attitude and the possibility of exceeding safe airspeed.

12. Apply as little pressure as possible on the control surfaces to prevent excessive strains on the aircraft structure.

13. Erratic altimeter indications may be expected.

8-52. Ice and Rain.

WARNING

RU-21D aircraft are prohibited from flight into known icing conditions. However, if flight into icing conditions is unavoidable, the loss of the HF DF mission antennas should be anticipated. Loss of antennas will be preceded by noticeable vibration prior to breakaway.

WARNING

Extend the engine ice vanes when temperature is 5°C or below before entering visible moisture. If the ice formation is allowed to progress to a critical point, the loss of intake air may make it impossible for the engine to run at normal power.

WARNING

Autoignition shall be used before entering anticipated or actual icing conditions (+10°C or below in visible moisture).

a. If flights into known icing conditions are made, all anti-icing and deicing systems of the aircraft should be properly utilized in accordance with the procedures detailed in Chapter 2. Rain presents no particular problems other than restricted visibility.

b. The aircraft is equipped with anti-icing and deicing systems to prevent the formation of ice on the pitot tube, stall warning vane, fuel vents, heater air intake, engine air intake, and propeller blades. Deicer boots are provided to remove ice from the wing and tail leading edges and an electrothermal windshield anti-ice system is provided to prevent ice from forming on the windshield. Windshield defrosters are installed to alleviate conditions resulting from frost or light ice. Windshield wipers are installed for rain removal at lower airspeeds. An engine ice vane is provided for removal of ice and rain from the engine intake air. An auto ignition system automatically provides combustion re-ignition if flameout should occur due to icing conditions, etc. If severe icing conditions are encountered, ascend or descend to altitudes where these conditions do not prevail. Operation of deice and anti-ice equipment discussed here is described in Chapter 2.

(1) *Icing.* Icing occurs because of supercooled water vapor such as fog, clouds, or rain. The most severe formation will generally occur at approximately −5°C.

(2) *Taxiing.* Extreme care must be exercised when taxiing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

(3) *Takeoff.* Extreme care must be excercised during takeoff from ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

(4) *Climb.* Climb at 10 to 15 KIAS above normal climb speeds when icing conditions exist. Reducing the angle of attack minimizes the accumulation of ice on all surfaces.

(5) *Cruising flight.* Prevention of ice formation is more effective and satisfactory than attempts to dislodge the ice after it has formed. If icing conditions are encountered, be alert to turn on the anti-icing systems prior to the first sign of ice formation. Refer to Chapter 2 for use of deicer boots. Flight in severe icing conditions should not be attempted. If ice forms on the wing area aft of the deicer boots, climb or descend to an altitude where conditions are less severe. At any time visible moisture is present, turn on the pitot and stall warning heat. Refer to Chapter 2 for additional information.

NOTE

Do not operate deicer boots continuously. Continuous operation tends to balloon the ice over the boots. Allow at least 1/2 inch of ice to accumulate on the boots, then activate the deicer boots to remove the ice. Repeat this procedure as required.

(6) *Landing.* Extreme care must be exercised when landing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

NOTE

Ice accumulation on the aircraft will result in higher stalling airspeeds due to the change in aerodynamic characteristics and increased weight of the aircraft due to ice buildup. Approach and landing airspeeds must be increased accordingly.

Section VI. CREW DUTIES

8-53. Crew/Passenger Briefing.

The following is a guide that should be used in accomplishing required crew/passenger briefings, when a unit crew/passenger briefing is not available. Items that do not pertain to a specific mission may be omitted.

a. *Crew introduction.*

b. *Equipment.*

- *(1)* Personal to include ID tags.
- *(2)* Professional.
- *(3)* Survival.

c. *Flight Data.*

- *(1)* Route.
- *(2)* Altitude.
- *(3)* Time in route.
- *(4)* Weather.

d. *Normal Procedures.*

- *(1)* Entry and exit of aircraft.
- *(2)* Seating.
- *(3)* Seat belts.
- *(4)* Movement in aircraft.
- *(5)* Internal communications.
- *(6)* Security of equipment.
- *(7)* Smoking.
- *(8)* Oxygen.
- *(9)* Refueling.
- *(10)* Weapons.
- *(11)* Protective masks.
- *(12)* Parachutes.

e. *Emergency Procedures.*

- *(1)* Emergency exits.
- *(2)* Emergency equipment.
- *(3)* Emergency landing/ditching procedures.
- *(4)* Bail out.

CHAPTER 9

EMERGENCY PROCEDURES

Section I. AIRCRAFT SYSTEMS

9-1. Aircraft Systems.

This section describes the aircraft systems emergencies that may reasonably be expected to occur and presents the procedures to be followed. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the condensed checklist TM 55-1510-209-CL-1. Emergency Procedures involving mission equipment is classified and published under a separate publication. Emergency operations of avionics equipment are covered when appropriate in Chapter 3, Avionics.

9-2. Immediate Action Emergency Checks.

Those checks that must be performed immediately in an emergency procedure are underlined. These immediate action emergency checks must be committed to memory.

NOTE

> The urgency of certain emergencies requires immediate and instinctive action by the pilot. The most important single consideration is aircraft control. All procedures are subordinate to this requirement.

9-3. Definition of Landing Terms.

The term LANDING IMMEDIATELY is defined as executing a landing without delay. (The primary consideration is to assure the survival of occupants.) The term LAND AS SOON AS POSSIBLE is defined as executing a landing to the nearest suitable landing area without delay. The term LAND AS SOON AS PRACTICABLE is defined as executing a landing to the nearest suitable airfield.

9-4. Emergency Exits and Equipment.

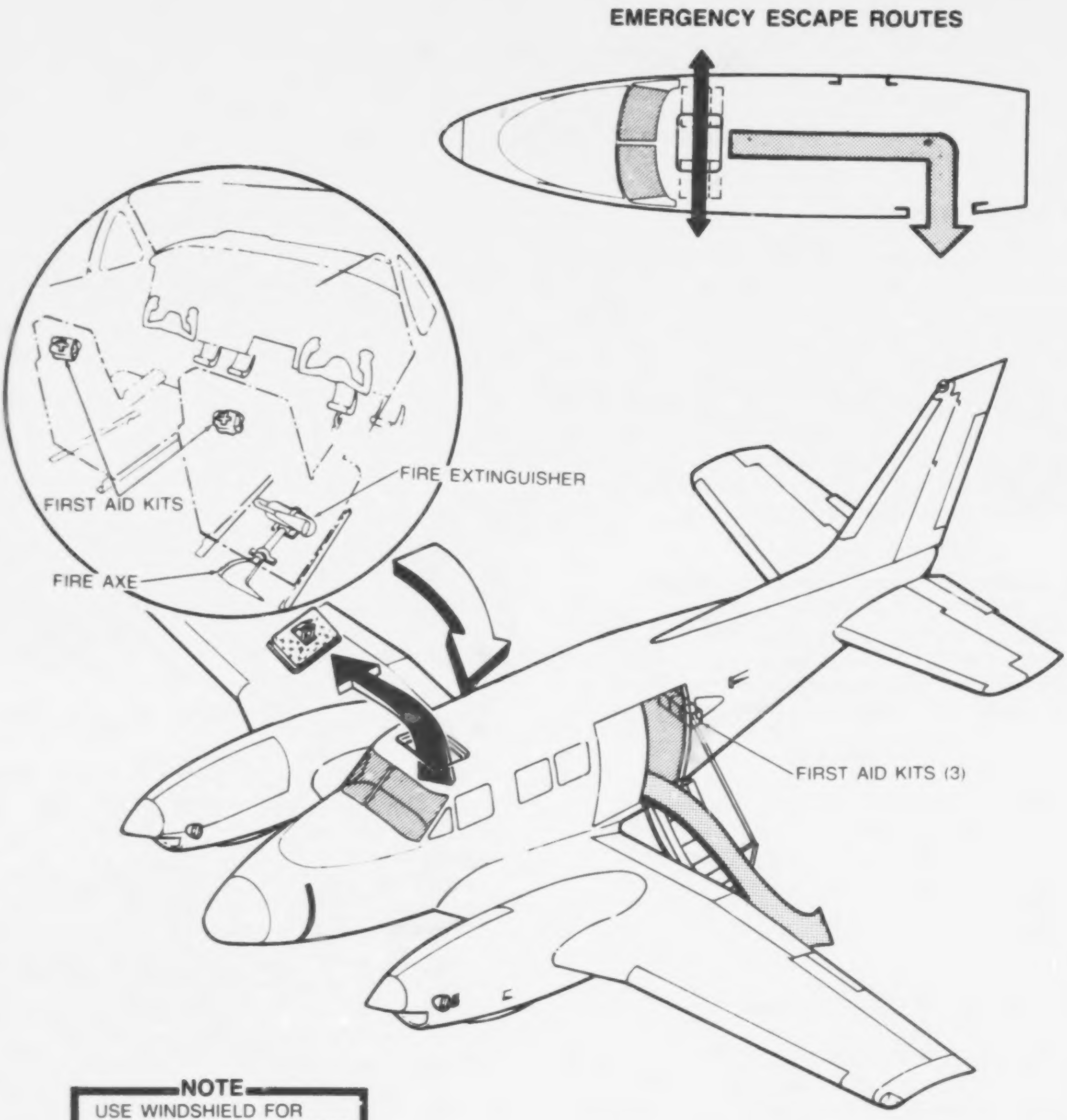
The main cabin entrance door is used for normal or emergency exit. A removable window (cabin emergency exit hatch) on the right side of the fuselage (fig. 9-1), and the cockpit emergency entrance/exit hatch are used for emergency exit only. The main cabin entrance door, the cabin emergency exit hatch (removable window), and the cockpit emergency entrance/exit hatch provide emergency escape routes from the aircraft either on the ground or when ditching.

9-5. Emergency Entrance.

If entry to the aircraft through the main entrance door is impossible or impractical, entry may be made through the alternate emergency exits (fig. 9-2). In order to open the cabin window emergency exit hatch, either the window must be broken through or the fuselage cut open along the dotted line stenciled CUT HERE FOR EMERGENCY RESCUE.

9-6. Engine.

a. Flight Characteristics Under Partial Power Conditions. Single-engine operations, due to an engine malfunction, are sometimes preceded by symptoms which will enable you to take preventative action. Complete engine failure most often occurs due to fuel starvation. This type of emergency situation is seldom due to mechanical causes, however, failure due to carelessness or improper operating techniques is not uncommon but may be avoided by constant attention to engine torque, turbine temperature, and fuel and oil pressure and temperature. These operating limitations are established and discussed in Chapter 5. If an engine malfunction is indicated, land as soon as practical. It is essential to have a thorough understanding of the principles affecting single-engine performance and the limitations resulting from the unbalance of power. Two principal factors govern flight safety on one engine: AIRSPEED and POWER, directional control being in proportion to airspeed. There are no unusual flight characteristics during single-engine operation as long as airspeed is maintained at or above minimum control speed (V_{mc}) and stall speed. Minimum control speed is the minimum airspeed for which lateral and/or directional control can be maintained with the flaps retracted, dead



NOTE
USE WINDSHIELD FOR
EMERGENCY WHEN OTHER
EXITS ARE INACCESSIBLE

▨ DITCHING EMERGENCY EXITS AND EMERGENCY ENTRANCE

▨ BAIL-OUT, DITCHING AND GROUND EMERGENCY EXIT

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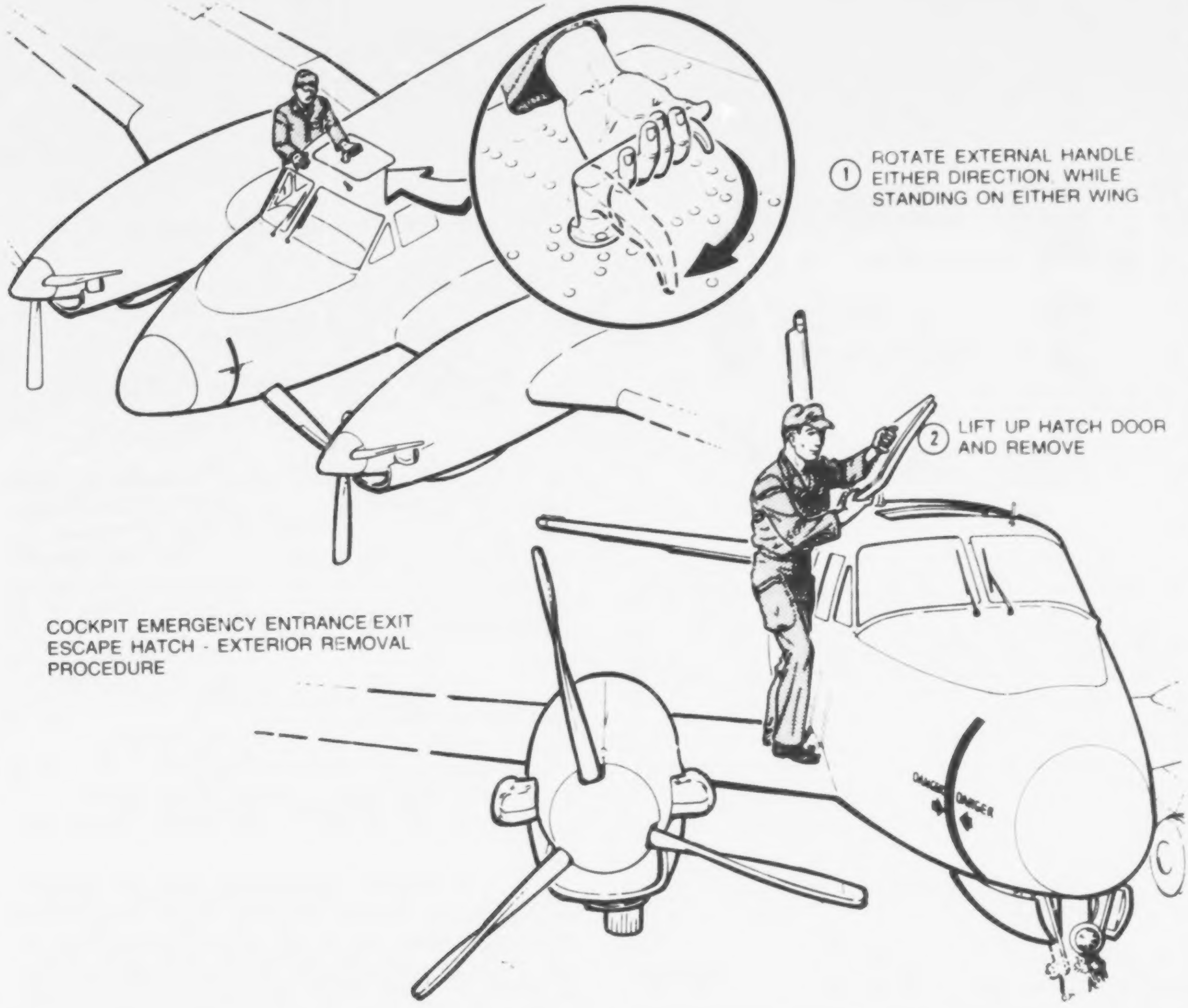
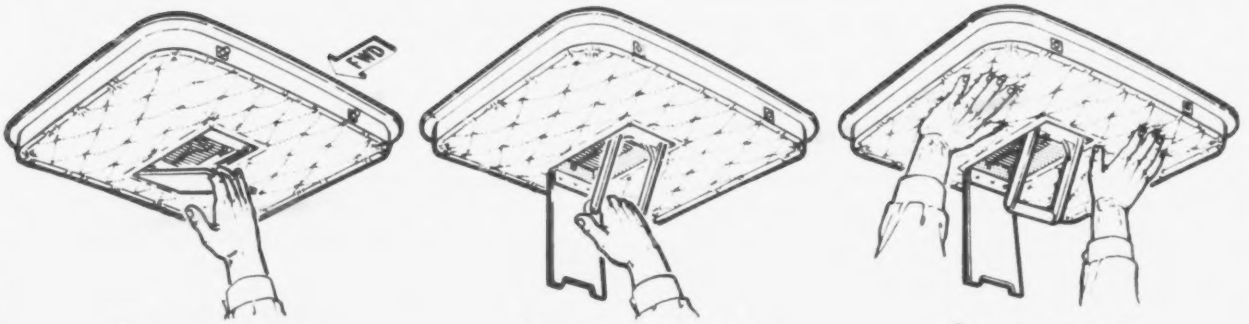
Figure 9-1. Emergency Exits and Equipment (sheet 1 of 2)



① ROTATE EXTERNAL HANDLE EITHER DIRECTION, WHILE STANDING ON EITHER WING

② LIFT UP HATCH DOOR AND REMOVE

COCKPIT EMERGENCY ENTRANCE/EXIT ESCAPE HATCH - EXTERIOR REMOVAL PROCEDURE



① PULL COVER DOWN

② PULL HANDLE DOWN

③ PUSH DOOR UP

COCKPIT EMERGENCY ENTRANCE/EXIT HATCH-INTERIOR JETTISON PROCEDURE

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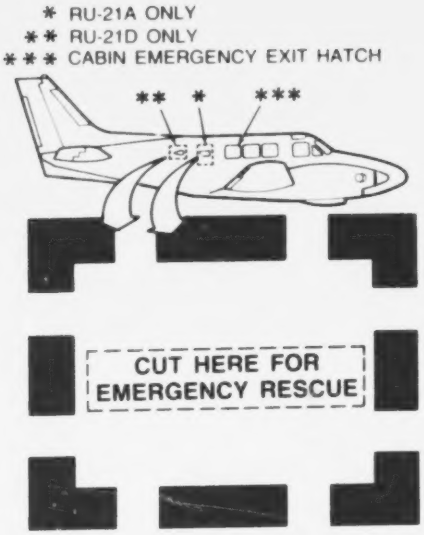
Figure 9-1. Emergency Exits and Equipment (sheet 2 of 2)



NOTE

EMERGENCY ENTRANCE MAY ALSO BE MADE BY BREAKING-IN THE WINDOW ON THE CABIN EMERGENCY EXIT HATCH (THE WINDOW SECTION JUST FORWARD OF THE RU-21A "CUT HERE FOR EMERGENCY RESCUE" AREA) AND ACTUATING THE HATCH RELEASE MECHANISM. HATCH RELEASE MECHANISM IS NOT ACCESSIBLE FROM INSIDE AIRCRAFT.

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Figure 9-2. Emergency Entrance

engine propeller feathered, live engine set to takeoff power and 5° maximum bank angle maintained toward the live engine (landing gear UP or DN). The capability of the aircraft to climb or maintain level flight depends on configuration, gross weight, altitude and free air temperature. Performance and control will improve by retracting the landing gear (if extended) and establishing the appropriate single-engine best rate-of-climb speed. Refer to Chapter 7 for single-engine climb performance.

b. Engine Malfunction During and After Takeoff. The action to be taken in the event of an engine malfunction during takeoff depends on whether or not takeoff speed has been attained. Refer to Chapter 7 for takeoff performance.

(1) Engine malfunction during takeoff run (abort). Below takeoff airspeed (V_{lof}) use the following procedure:

NOTE

Single-engine reversing may be applied if required. Use extreme caution if takeoff surface is not hard and dry.

1. Power – IDLE.
2. Braking – As required.

NOTE

Braking action is impaired if wheels are allowed to skid.

(2) Engine malfunction immediately after takeoff below takeoff airspeed (V_{lof}) (sufficient runway remaining). If an obstacle clearance or minimum run takeoff has been made and takeoff airspeed (V_{lof}) has not been reached prior to engine malfunction, and sufficient runway remains for a landing, proceed as follows:

1. Power – Reduce (as required to maintain directional control).
2. Land the aircraft.
3. Braking – As required.

(3) Engine malfunction immediately after takeoff below takeoff airspeed (V_{lof}) (insufficient runway remaining). If an obstacle clearance or minimum run takeoff has been made and takeoff airspeed has not been reached prior to engine malfunction, sufficient altitude is not available to attain takeoff airspeed and insufficient runway remains for a landing, avoid a stall and proceed as follows:

1. Power – IDLE.
2. Land – Straight ahead.
3. Fuel firewall valves – CLOSED (LEFT and RIGHT).
4. Master switch – Down.

(4) Engine malfunction after takeoff (flight continued). If an engine malfunctions, after becoming airborne, and best single engine climb speed has been attained, proceed as follows:

NOTE

Do not retard the malfunctioning engine power lever, or turn the autofeather system OFF, until propeller rotation is completely stopped. To do so will deactivate the autofeather circuit and prevent automatic feathering.

NOTE

If the autofeather system fails to operate, identify the dead engine, retard the power lever of suspected engine to confirm identification, then feather the propeller for the dead engine.

1. Gear – UP.
2. Flaps – UP.
3. Power – As required.
4. Airspeed – Best single-engine rate of climb (V_{yse}).
5. Engine clean up – Perform.

c. Engine Malfunction During Flight. Refer to Chapter 7 for single-engine cruise information. If one engine malfunctions during flight, maintain directional control and proceed as follows:

NOTE

If the situation permits, analyze the malfunction and take appropriate action to restore power.

1. Power – As required.

NOTE

If an engine malfunctions during climb-out, cruise, or descent and automatic feathering is desired, place the autofeather switch in the ARM position with the power levers above the 90% N1 position (AUTOFEATHER lights illuminated).

2. Dead engine – Identify.
3. Power lever (dead engine) – IDLE.
4. Propeller (dead engine) – FEATHER.
5. Condition lever (dead engine) – FUEL CUTOFF.
6. Gear – UP.
7. Flaps – UP.
8. Power – Set (for single-engine cruise).
9. Engine clean up – Perform.

d. Engine Cleanup. Clean up procedure to be used after engine malfunction or an unsuccessful restart is as follows:

1. Boost pump (dead engine) – OFF.
2. Crossfeed – CLOSED (if no restart is to be attempted).
3. Fuel firewall valve (dead engine) – CLOSED (if no restart is to be attempted).
4. Generator (dead engine) – OFF.
5. Electrical load – Monitor.

(O) 6. Autoignition (dead engine) – OFF.

7. Fuel control heat – OFF (dead engine, if no restart is to be attempted).

(O) 8. Mission equipment power switch – As required.

(O) 9. Mission avionics DC power switch – As required.

e. Engine Malfunction During Final Approach. If an engine malfunctions during final approach (after LANDING CHECK), and the autofeather system fails to operate, the propeller should not be feathered unless time and altitude permit or conditions require it. Continue approach using the following procedure:

1. Power – As required (to assure landing in required area).
2. Gear – Recheck DN.

NOTE

100% flaps must be used to obtain the minimum landing distances in Chapter 7.

f. Engine Restart During Flight (Using Starter). Successful restarts may be achieved at all altitudes normally flown. Do not attempt to restart the engine unless it can be determined that no damage to the engine will result and no additional hazard will be created. If in doubt, continue single-engine flight and land the aircraft as soon as practicable.

CAUTION

For RU-21A aircraft, do not exceed starter limitation of 40 seconds on, and 60 seconds off for two starter operations; then 40 seconds on, 30 minutes off.

CAUTION

For RU-21D aircraft, observe starter limits of 2 minutes on, 3 minutes off, 2 minutes on, 30 minutes off.

1. Electrical load – Reduce to minimum.
2. Power lever (dead engine) – IDLE.
3. Propeller (dead engine) – FEATHER.
4. Condition lever (dead engine) – FUEL CUTOFF.
5. Boost pumps (2) – ON.
6. Crossfeed – AUTO.
7. Fuel control heat – ON.
8. N_1 (live engine) – Reduce (90% or below to preclude exceeding the ITT temperature limit, 750°C).
9. Ignition/start switch – ON (monitor IGN ON light illuminated, N_1 over 13% and stabilized for approximately 5 seconds).
10. ITT (live engine) – Monitor (750°C maximum).

CAUTION

If ignition is not evident in 10 seconds after moving the condition lever to LO IDLE, position the condition lever to FUEL CUTOFF and the ignition/start switch to OFF. Accomplish ENGINE CLEARING procedure (Chapter 8). If another restart attempt is to be made, repeat the entire ENGINE RESTART procedure.

11. Condition lever – LO IDLE.
12. ITT and N_1 – Monitor (1090°C maximum).

NOTE

When N_1 RPM is below 13% starting temperatures tend to be higher than normal. To preclude overtemperature (1090°C or above) during engine acceleration to idle speed, momentarily move the condition lever into FUEL CUTOFF position as necessary.

13. Ignition/start switch – OFF, (when N_1 is above 50%, or start attempt is discontinued).
14. Engine clean up – Perform (if restart is unsuccessful).
15. Oil pressure – Check (40 PSI minimum).
16. Generator – On.
17. Propeller – Synchronize.
18. Power – As required (after engine is stabilized at idle).
19. Electrical equipment – As required.

g. Engine Restart During Flight (No Starter Assist, Engine and Propeller Windmilling). A restart without actuating the starter may be accomplished provided certain conditions exist. The reason for engine malfunction should be determined before attempting a restart. If altitude permits, diving the aircraft will increase engine RPM and assist in restart.

1. Electrical load – Reduce to minimum.

2. Power lever (dead engine) – IDLE.

3. Propeller (dead engine) – HIGH RPM.

4. Condition lever (dead engine) – FUEL CUTOFF.

5. Boost pumps (2) – ON.

6. Crossfeed – AUTO.

7. Generator (dead engine) – Off.

8. Fuel control heat – ON.

9. Airspeed – 160 KIAS (minimum).

10. Altitude – Below 20,000 feet.

11. Autoignition – ARM.

CAUTION

If ignition is not evident in 10 seconds after moving the condition lever to LO IDLE, position the condition lever to FUEL CUTOFF and the autoignition switch, to OFF. If another restart attempt is to be made, repeat the entire ENGINE RESTART procedure.

12. Condition lever – LO IDLE.

NOTE

When N_1 is below 13%, starting temperatures tend to be higher than normal. To preclude overtemperature (1090°C or above) during engine acceleration to idle speed, momentarily move the condition lever into FUEL CUTOFF position as necessary.

13. ITT and N_1 – Monitor (1090°C maximum).

14. Engine clean up – Perform (if restart is unsuccessful).

15. Oil pressure – Check (40 PSI minimum).

16. Generator – On (when N_1 is above 50%).

17. Propeller – Synchronize.

18. Power – As required.

19. Autoignition – As required.

20. Electrical equipment – As required.

21. Crossfeed – As required.

h. Fuel Pressure Drop – Engine Operating Normally. Refer to (para. 9-7) FUEL SYSTEM EMERGENCIES, for fuel boost failure.

i. Maximum Glide. In the event of failure of both engines, maximum gliding distance can be obtained by feathering both propellers to reduce propeller drag and by maintaining appropriate airspeed (fig. 9-3 or 9-4) with the gear and flaps up. Turn off all electrical equipment to conserve battery power for extending the gear and flaps, but leave the master switch ON. Refer to the Maximum Glide Distance Charts (fig. 9-3 or 9-4).

j. Landing With One Or More Engines Inoperative.

NOTE

With one engine inoperative level flight cannot be assured with full flaps and the landing gear down.

(1) Single-engine landing. Fly a normal pattern and perform Single Engine Before Landing Checks as appropriate. Extend flaps beyond the approach position only if required, and then only after there is no possibility of a go-around. Plan for a slightly higher than normal approach, allowing for sufficient straight-away on final, so minor alignment, speed, and altitude corrections can be accomplished without excessive low altitude maneuvering. Do not extend full flaps until gear is down and locked. Make a normal touchdown, reducing power during flareout. Avoid excessive or abrupt changes in power. A feathered propeller will result in less drag and may cause the aircraft to float during landing. After touchdown, apply brakes and propeller reversing as required.

NOTE

Single-engine reversing may be applied if required. Use extreme caution if landing surface is not hard and dry.

MAXIMUM GLIDE DISTANCE

GLIDE DISTANCE
RU-21A
T74-CP-700

ASSOCIATED CONDITIONS:

1. POWER OFF (PROPELLERS FEATHERED)
2. GEAR AND FLAPS UP
3. ZERO WIND
4. AIRSPEED AND WEIGHT COMBINATIONS SHOWN PRODUCE MAXIMUM GLIDE DISTANCE

WEIGHT – LBS.	BEST GLIDE SPEED KIAS
10,200	113
9000	105
8000	99
7000	92

WANTED

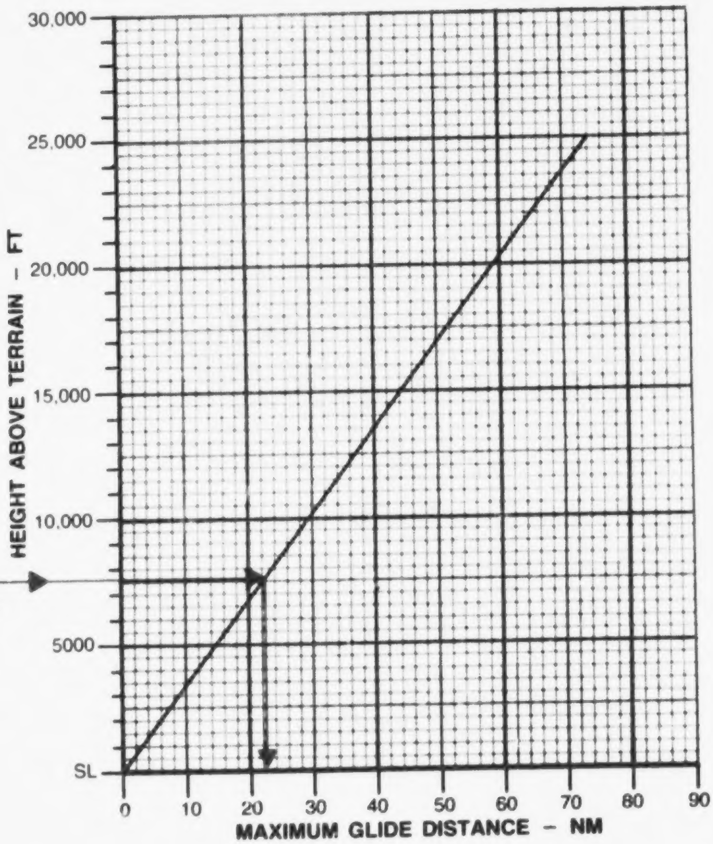
MAXIMUM GLIDE DISTANCE

KNOWN

HEIGHT ABOVE TERRAIN = 7400 FT.

METHOD

ENTER HEIGHT ABOVE TERRAIN HERE
MOVE RIGHT TO MAXIMUM GLIDE DISTANCE LINE
MOVE DOWN, READ MAXIMUM GLIDE DISTANCE = 22 NM



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DATA BASIS: ESTIMATED

Figure 9-3. Maximum Glide Distance RU-21A

MAXIMUM GLIDE DISTANCE

GLIDE DISTANCE
RU-21D
T74-CP-700

ASSOCIATED CONDITIONS:

1. POWER OFF (PROPELLERS FEATHERED)
2. GEAR AND FLAPS UP
3. ZERO WIND
4. AIRSPEED AND WEIGHT COMBINATIONS SHOWN PRODUCE MAXIMUM GLIDE DISTANCE

WEIGHT — LBS.	BEST GLIDE SPEED KIAS
9650	112
9000	108
8000	102
7000	94
6000	87

EXAMPLE

WANTED

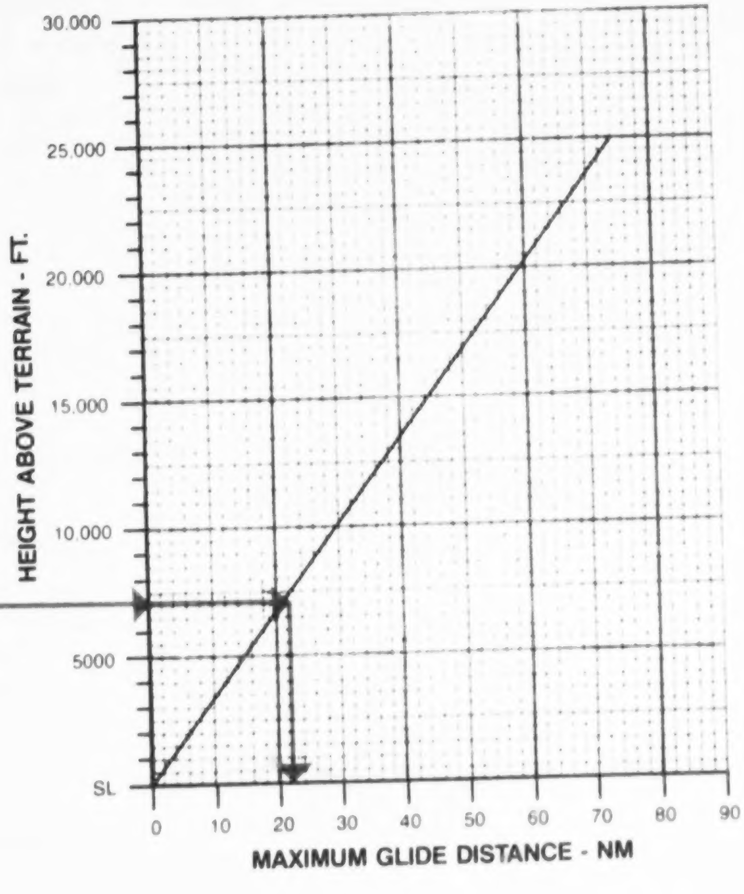
AXIMUM GLIDE DISTANCE

KNOWN

EIGHT ABOVE TERRAIN = 7400 FT

METHOD

NTER HEIGHT ABOVE TERRAIN HERE
OVE RIGHT TO MAXIMUM GLIDE DISTANCE LINE
OVE DOWN, READ MAXIMUM GLIDE DISTANCE = 22 NM



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DATA BASIS: ESTIMATED

Figure 9-4. Maximum Glide Distance **RU-21D**

(2) Forced landing – no power. If sufficient altitude remains after reaching a suitable landing area, a circular pattern will provide best observation of surface conditions, wind speed and direction. When the condition of the terrain has been noted and the landing area selected, set up a rectangular pattern and extend the gear when landing is assured. Fly the base leg as necessary to control point of touchdown. Plan to overshoot rather than undershoot using flaps as necessary. Keep in mind that with both propellers feathered, the normal tendency is to overshoot due to less drag. In the event a possible gear down and locked indication cannot be determined, prepare for a gear up landing. Refer to LANDING EMERGENCIES (para. 9-10).

(3) Single-engine descent-arrival check. Perform the following checks prior to traffic pattern entry:

1. Seat belts and shoulder harnesses – Secure (passengers checked).
2. Fuel panel – Check.
3. Parking brake handle – In.
4. Engine ice vanes – As required.
5. Mission Power – OFF.

(4) Single-engine before landing check. Perform the following checks upon pattern entry:

1. Flaps – APPROACH (below 173 KIAS).

NOTE

To prevent the mode 4 computer from zeroizing, the transponder, when the landing gear is down (struts compressed) and either transponder or aircraft power is to be turned off – place the CODE switch momentarily in HOLD Position.

2. Gear – DOWN (below 154 KIAS). Check lights.
3. Landing lights – ON.

(5) Single-engine landing check.

NOTE

100% flaps must be used to obtain the minimum landing distances in Chapter 7.

1. Gear – Recheck DN (check lights).
2. Propeller (live engine) – HIGH RPM.

WARNING

Once the flaps are full DOWN on a single-engine landing, do not attempt a go-around.

k. Single Engine Go-Around. The decision to go around must be made as early as possible. Elevator forces at the start of a go-around are very high and a considerable amount of rudder control will be required at low airspeeds. Retrim as required. If rudder application is insufficient or applied too slowly, directional control cannot be maintained. If control difficulties are experienced, reduce power on the operating engine immediately. Ensure that the airplane will not touch the ground before retracting the landing gear. Retract the flaps only as safe airspeed permits (APPROACH until Vref used for APPROACH, then UP). Perform single go-around as follows:

NOTE

Once flaps are fully extended, a single engine go-around may not be possible when close to ground under conditions of high gross weights and/or high density altitude.

1. Power — Maximum controllable.
2. Gear — UP.
3. Flaps — UP.
4. LANDING LIGHTS — OFF.
5. Power — As required.

l. Chip Detector Warning Light On. The illumination of either chip detector light on the annunciator panel will require the following immediate procedures:

1. Engine instruments – Monitor.

2. Land as soon as practical.

9-7. Propeller.

a. Propeller Failure. Normally the primary governor controls the speed of the propeller within the range of 1750 to 2200 RPM. If the primary governor fails, the propeller will either feather or over speed. Two additional governors control on overspeed condition. The first is the overspeed governor. When the propeller speed reaches 2288 RPM, the overspeed governor maintains the propeller speed near 2288 RPM. If the primary and overspeed governors should fail, the power turbine governor becomes effective at 2332 RPM and will reduce the flow of fuel to the engine. If an overspeed condition occurs that cannot be controlled with the propeller lever or by reducing power, feather the propeller. If the propeller feathers by itself complete the feathering procedure. The engine with the disabled propeller may be operated to provide electrical power for systems needed in flight. The procedure to follow in the event of propeller failure is as follows:

1. Airspeed – Reduce (increase aircraft pitch attitude).

2. Power (failed prop) – IDLE.

3. Propeller (failed prop) – FEATHER.

b. Secondary Low Pitch Stop Light On. The procedure to follow in the event of illumination of a secondary low pitch stop light is as follows:

1. Propeller RPM and engine torque – Monitor.

2. The action to be taken depends on torque and propeller speed:

WARNING

Propeller RPM increase and torque decrease when a light illuminates indicates a malfunction in the primary governor system and/or the hydraulic low pitch stop. The overspeed governor will prevent RPM from exceeding 2288. DO NOT pull the PROP GOV IDLE STOP circuit breaker, as this could cause propeller reversal. Secure engine as soon as practical.

(1) If propeller RPM increases and engine torque decreases – Secure engine as soon as practical.

WARNING

While operating with the PROP GOV IDLE STOP circuit breaker pulled, the secondary low pitch stop system is inoperative. Should the primary hydraulic low pitch stop fail, the propeller will reverse when power is reduced.

(2) If propeller RPM decreases and engine torque increases – Pull PROP GOV IDLE STOP circuit breaker immediately (on right subpanel).

NOTE

Propeller RPM decrease and torque increase indicates malfunction of the secondary low pitch stop system which will cause the propeller to feather within 10 to 60 seconds. In this event, PULL the PROP GOV IDLE STOP circuit breaker and continue flight to destination. Malfunction of the secondary low pitch stop must be corrected before further flight.

(3) If propeller RPM and torque remain stable, reset the PROP GOV IDLE STOP circuit breaker.

9-8. Fire.

a. Engine Fire. The following procedures indicate the action to be taken in case of engine fire.

NOTE

No engine fire extinguisher systems are installed.

(1) Engine/nacelle fire during start or ground operation. If a nacelle fire should develop during start or ground operations, proceed as follows:

1. Fuel firewall valves – CLOSED (LEFT and RIGHT).

2. Master switch – Down.

3. Parking brake – Set.

4. Propellers – FEATHER.

5. Evacuate aircraft.

CAUTION

If fire extinguishers are used to extinguish an engine fire, do not attempt to restart until the cause has been determined, and corrected, and all fire extinguishing agent residue removed.

6. Fight the fire immediately with all available fire extinguishing equipment.

(2) *Engine fire during flight.* In the event an engine fire develops during flight, shut down the affected engine in the following manner:

1. Fuel firewall valve – CLOSED.

2. Power – IDLE.

3. Propeller – FEATHER.

4. Condition lever – FUEL CUTOFF.

5. Boost pump – OFF.

6. Transfer pump – OFF.

7. Crossfeed – CLOSED.

b. Fuselage Fire. Most fuselage fires can be reached with the hand-operated portable fire extinguisher. Keep all windows and entrance door closed. If a fuselage fire occurs, perform the following:

(O) 1. Oxygen – 100%/as required.

2. Vent blower – OFF.

3. Heater – OFF.

WARNING

Exposure to high concentrations of monobromotrifluoromethane (CF_3Br) or its decomposition products should be avoided. The liquid should not be allowed to come into contact with the skin, as it may cause frost bite or low temperature burn because of its very low boiling point.

4. Fight the fire immediately with all available fire extinguishing equipment.

5. If fire cannot be extinguished – Land immediately and evacuate the aircraft.

c. Wing Fire. There is little that can be done to control a wing fire except to shut off fuel and electrical systems that may be contributing to the fire, or which could aggravate it. Slipping the aircraft away from the burning wing may help.

WARNING

Land the aircraft immediately, or bail out, depending on circumstances and seriousness of the fire.

d. Electrical Fire. All circuits are protected by circuit breakers, which tends to prevent an electrical fire. Upon noting the existence of an electrical fire, immediately turn off all affected electrical circuits, if known.

If electrical fire source is unknown, proceed as follows:

1. Master switch – Down.

2. All electrical switches – OFF.

3. Battery – ON.

4. Generators – On.

5. Essential equipment – ON (individually until fire source is isolated).

NOTE

With battery switch and generator switches turned OFF, landing gear, wing flaps, and auxiliary and transfer pump circuits will be inoperative. If deemed reasonably safe, turn on battery or generator switch long enough to extend the landing gear and then turn it off again. Otherwise extend the landing gear manually and land with the wing flaps up.

e. Smoke and Fume Elimination. If dense smoke remains after the fire is extinguished, open the cockpit vent/storm windows.

(O) 1. Crew oxygen masks – On.

(O) 2. Passenger masks – On. The copilot should confirm that all passengers are receiving supplemental oxygen.

3. Cockpit vent/storm windows – Open as required.

9-9. Fuel System.

a. Fuel System Emergencies. The engine will operate with fuel boost pump failure. However, failure of an engine-driven (high pressure) fuel pump will result in engine fuel starvation. Perform the SINGLE-ENGINE procedure and land as soon as practicable.

CAUTION

Do not use fuel firewall valve to shut down engine operation, except in an emergency. The engine-driven high-pressure fuel pump obtains essential lubrication from fuel flow. When an engine is operating, this pump may be severely damaged (while cavitating) if the firewall valve is closed before the condition lever is moved to the FUEL CUTOFF position.

b. Fuel Leaks/Syphoning. The action to be taken in the event of fuel leaks or syphoning depends upon the origin and severity of fuel loss.

(1) If fuel filler cap syphoning occurs proceed as follows:

1. Power – Reduce.

2. Airspeed – 120 KIAS.

3. Land as soon as practicable (maximum flap setting, APPROACH.)

(2) If wing/nacelle fuel leaks are evident proceed as follows:

1. Power – As required.

2. Power lever (affected engine) – IDLE.

3. Propeller (affected engine) – FEATHER.

4. Condition lever (affected engine) – FUEL CUTOFF.

5. Fuel firewall valve (affected engine) – CLOSED.

6. Gear – UP.

7. Flaps – UP.

8. Power – Set.

9. Engine clean up – Perform.

10. Land as soon as practicable.

c. Fuel System Crossfeed Single-Engine Operation. During single-engine operation the fuel supply for the dead engine may be used to supply the live engine by routing the fuel through the crossfeed system. Use the following procedure for fuel crossfeed during single-engine operation:

1. Fuel firewall valve (dead engine) – CLOSED.

2. Boost pump (dead engine) – ON.

3. Crossfeed – OPEN.

4. Fuel crossfeed light – Check illuminated.

NOTE

With a fuel firewall valve closed, the respective BOOST FAIL light may be illuminated, but the indication will lack significance due to the closed position of the firewall valve.

5. Transfer pump (dead engine) – ON.

6. Boost pump (live engine) – Check OFF (side receiving crossfeed).

7. Fuel pressure – Verify (live engine).

8. Crossfeed and fuel quantity – Monitor.

d. Fuel Transfer – Manual. A no fuel transfer condition is indicated by illumination of a yellow LH NO FUEL TRANSFER or RH NO FUEL TRANSFER light on the annunciator panel, and the simultaneous flashing of both FAULT WARN lights. Manual refill of a nacelle tank is conducted with the TRANSFER PUMP switch ON, and is initiated by holding the respective TRANSFER TEST switch in the selected position (L or R). The switch may or may not be released after fuel transfer has started. If the TRANSFER TEST switch is released, fuel transfer will be stopped by either 24 or 57-gallon float switch. If the TRANSFER TEST switch is held ON, the transfer pump will continue to run (overriding the float switches) until all available fuel is transferred. The pump will then automatically shut off and the appropriate NO FUEL TRANSFER light will illuminate on the annunciator panel, indicating that no more fuel is available for transfer. However, if transferable fuel remains in the wing tanks after the nacelle tank is filled to capacity, continuing to hold the TRANSFER TEST switch ON will only circulate fuel between the nacelle tank and the wing tanks.

NOTE

With fuel remaining in the wing tanks, illumination of the NO FUEL TRANSFER light, after manual activation of the TRANSFER TEST switch, indicates transfer pump failure.

e. Operation After Boost Pump Failure.

WARNING

During operation after boost pump failure, the CROSSFEED switch must be placed in the CLOSED position to prevent using fuel from the boosted side only. This would result in aircraft imbalance and eventual fuel starvation of the engine with the operating boost pump.

CAUTION

Engine operation using only the engine-driven fuel pump without fuel boost pressure is limited to 10 cumulative hours. All time in this category shall be entered on DA Form 2408-13 for the attention of maintenance personnel.

Should a situation arise where a boost pump fails and the crossfeed switch is in the AUTO position, automatic crossfeed will start. With a boost pump not operating, the engine can continue to operate (sometimes at reduced power) from its own fuel supply on engine-driven pump pressure only. To do this, place the crossfeed switch in the CLOSED position. The engine will then continue to operate from its own fuel supply (fig. 2-20). After landing, both fuel boost pumps should be operable before next flight.

9-10. Electrical System.

WARNING

If battery overheats, do not open battery compartment or attempt to disconnect or remove battery. Battery fluid will cause burns, and overheated battery could cause thermal burns and may explode.

CAUTION

Circuit breakers should not be reset more than once until the cause of circuit malfunction has been determined and corrected.

a. Electrical Power System Failure. In the event both generators and the battery are shut off, the flaps will be inoperative, and the landing gear must be extended manually. All systems (except the stall warning horn) which utilize DC power for operation (including the AC power system) will be inoperative.

CAUTION

Only one attempt should be made to restore an inoperative generator to use.

b. Generator Failure. Both generators are required to power the full load of electrical equipment, the loss of either generator requires that mission equipment be turned off. If one generator becomes inoperative, all non-essential electrical equipment should be used judiciously to avoid overloading the remaining generator. Loads in excess of single generator output will drain the battery, with the resultant loss of reserve and emergency power. The choice of equipment to be used will be determined by existing conditions. The use of accessories which create a very high drain, should be avoided. If both generators are shut off due either to generator failure, ground fault (RU-21D) or engine failure, all equipment should be turned off to preserve battery power for extending the landing gear and wing flaps. The general location of failure within the aircraft electrical system may be indicated by illumination of the respective GEN OUT annunciator panel red light, and the simultaneous flashing of the FAULT WARN light. Illumination indicates one of three conditions: generator failure, generator overvoltage, or a faulted generator feeder cable. If the indicated generator cannot be returned to the line, reduce load on the remaining generator to a volt-loadmeter reading of 1.0 or less for continuous operation.

c. One Gen Out Light Illuminated, With Flashing Fault Warn Lights. **RU-21D** Other indications will be: some aircraft systems dead, corresponding volt-loadmeter shows no load, no circuit breakers are tripped. (Probable cause: The generator ground fault detector has sensed a faulted feeder cable, isolated the faulted cable and shut off the affected generator.) Proceed as follows:

CAUTION

Attempt generator reset one time only.

1. Generator – Reset, then ON.

2. Generator (GEN OUT light remains illuminated) – Off.

3. Electrical equipment – OFF, as required to reduce generator load to 1.0 or less.

NOTE

In no case, will a single ground fault affecting either generator feeder cable, or affecting the tie-in cable between the generator buses, cause the loss of more than one power source.

d. One Gen Out Light Illuminated, With Flashing Fault Warn Light. **RU-21A** Other indications will be: all aircraft systems working, corresponding volt-loadmeter shows no load, no circuit breakers are tripped. (Probable cause: an open reverse current diode, a faulty generator control unit, or a bad generator ground.) Proceed as follows:

1. Generator – ON.

2. Generator (GEN OUT light remains illuminated) – OFF.

3. Electrical equipment – OFF, as required to reduce generator load to 1.0 or less.

NOTE

In no case, will a single fault which causes a generator to be shut off cause the loss of more than one power source.

e. Divergent Volt-Loadmeter Readings. Other indications will be: all aircraft systems are working, and both generators are operating. There should be no cause for alarm. Generator load-sharing (paralleling) is lost, however all systems should continue to operate with the loads receiving power from one generator or the other. (Probable cause: a faulty generator paralleling control circuit or an open bus isolation limiter.) There is no procedure by which the pilot may restore generator paralleling during flight.

f. Battery Fault Reset Light Illuminated. **RU-21D** Other indications will be: all aircraft systems are working, both generators are operating, divergent readings on volt-loadmeters, battery power is lost to aircraft circuits, and BATTERY CONTROL RELAY circuit breaker is tripped or not tripped. There should be no cause for alarm. Generator load-sharing (paralleling) is lost, however all systems should continue to operate with the loads receiving power from one generator or the other. (Probable cause: battery cross-tie cable fault only, or battery cross-tie cable fault with an overload condition detected by the current sensor.) Proceed as follows:

CAUTION

Perform the following step (2), if applicable, only if the BATTERY FAULT RESET light is extinguished.

1. BATTERY FAULT RESET switch – Press to RESET, check switch light extinguishes.

NOTE

Attempts to reset the BATTERY FAULT RESET switch are not harmful. Several reset attempts may be tried.

2. Battery control relay circuit breaker (if tripped) – Reset.

NOTE

In no case, will a fault in a battery cross-tie cable or a battery overload cause the loss of more than one power source.

g. Battery Control Relay Circuit Breaker Tripped **RU-21D** Other indications will be: none visible. Battery power is lost to aircraft circuits and the battery cannot receive charge. There is no cause for alarm. All systems are receiving power. Both generators are operating and are paralleled. (Probable cause: battery was overloaded or faulted to ground.) Proceed as follows:

CAUTION

Attempt to reset the BATTERY CONTROL RELAY circuit breaker only one time.

1. Battery control relay circuit breaker – Reset.

2. Battery switch – OFF, if BATTERY CONTROL RELAY circuit breaker will not reset.

NOTE

In no case, will a battery which is overloaded or faulted to ground cause the loss of more than one power source.

h. Inverter Failure. The MAIN INVERTER and STBY inverter are each capable of carrying the full load of normally required single-phase AC power. The INERTIAL and STBY inverters are each able to supply all aircraft requirements for 3-phase AC power. Inverter failure illuminates either the MAIN INV OUT or STBY INV OUT red annunciator light. The procedure in the event of inverter failure is as follows:

NOTE

The INS system, should always use the MAIN INVERTER to supply single-phase aircraft requirements. The automatic phase-switching circuit of the STBY inverter gives preference to single-phase requirements. Should a fault condition shut off the INERTIAL inverter, while the STBY inverter is operating in single-phase mode, INS system operation will terminate due to three-phase power starvation. Even if three-phase power is restored to the INS system, alignment will be lost.

i. Inverter Out Light Illuminated.

1. Inverter – Select other inverter.

NOTE

When inverters are switched, the standby compass will be affected.

2. Inverter control circuit breakers – Reset.

NOTE

Allow at least a 30 second cooling period before resetting inverter control circuit breaker.

3. Inverter lights remain illuminated – Return to original inverter.

4. Inverter lights still remain illuminated – Inverter OFF.

CAUTION

With loss of AC power, the TACAN cooling blower is inoperative and TACAN equipment may be damaged.

5. TACAN – OFF.

6. Land as soon as practicable.

j. Feeder Bus Failure. Equipment receiving power from a failed feeder bus should not be returned to service. The electrical load can be reduced by turning OFF all non-essential electrical equipment.

k. Battery Monitor Light Illuminated. Illumination of the battery monitor light indicates excessive charge of battery. This is a normal function after a battery start or after lowering gear and flaps. However, illumination during normal steady-state cruise flight indicates that conditions exist that may cause a battery thermal runaway. Proceed as follows:

1. Battery switch – OFF.

2. Loadmeter – Check.

NOTE

A decrease reading of 0.25 or more graduation (approximately one needle width) verifies a deteriorating battery. Leave battery switch OFF for remainder of flight.

3. Battery condition good – Battery switch ON.

4. Battery condition unsatisfactory – Battery ON for flap and landing gear extension only.

5. Battery – OFF.

9-11. Door Open Light Illuminated.

1. Do not attempt to close door.

2. Land as soon as practicable.

9-12. Emergency Descent.

Emergency descent is a maximum effort in which damage to the aircraft must be considered secondary to getting the aircraft down. For emergency descent, proceed as follows:

CAUTION

Do not practice EMERGENCY DESCENT procedure because damage to landing gear doors will result.

1. Power – IDLE.

2. Propellers – HIGH RPM.

3. Gear – DOWN.

4. Flaps – UP.

5. Airspeed – V_{mo} (208 KIAS).

9-13. Landing Emergencies.

WARNING

The heater must be shut down prior to all emergency landings to minimize fire hazard.

a. Landing Gear System Failure. Should one or more of the landing gear fail to extend, or fail to indicate a safe condition, the following steps should be taken before proceeding manually to extend the gear.

1. Gear control circuit breaker – Check.

2. Gear indicator circuit breaker – Check.

CAUTION

If the LANDING GEAR POWER circuit breaker is tripped, allow approximately three minutes cooling time before resetting.

3. Gear power circuit breaker – Check.

4. Gear indicators – Check.

5. Gear handle – UP, then DOWN.

6. Gear position – Check (use air-to-air or air-to-ground fly-by method for visual landing gear position verification).

b. Landing Gear Emergency Extension. The landing gear may be extended manually if the electrical portion of the extension mechanism should fail. As airspeed is reduced, it is correspondingly easier to manually actuate the emergency extension handle. When making an emergency gear extension, proceed as follows:

1. Airspeed – Below 154 KIAS.

2. Gear power circuit breaker – Out (pulled).

3. Gear handle – DN.

4. Gear emergency clutch disengage lever – Pull up and turn clockwise.

CAUTION

Do not pump handle after GEAR DOWN position indicator lights (3) are illuminated. Further movement of the handle could damage the drive mechanism.

5. Gear emergency extension handle – Pump the handle up and down until the three GEAR DOWN green lights illuminate. In the event of complete electrical failure, pump until resistance is felt.

NOTE

The landing gear cannot be retracted manually.

WARNING

RU-21D wing-mounted, mission antennas have shear or breakaway capabilities, however, experience has shown that the antennas may remain attached after ground contact is made. The pilot should be aware that the inboard nacelle antennas will be the first point of contact when the landing gear is retracted or retracts at touchdown. The aircraft will settle next on the outboard antennas. Should one antenna remain intact and the other fail, the aircraft may become uncontrollable. Should both antennas remain intact, the main gear may not touch the runway. The pilot should attempt to make wing level, slightly nose high attitude landings.

c. Gear-Up Landing. The main landing gear wheels protrude slightly from the wheel well in the gear-up position and will roll when the aircraft is landed with the gear retracted. Due to decreased drag with the gear up, the tendency will be to overshoot the approach. It is recommended that the landing be made with full flaps on a hard surface runway, preferably paved. In landing on soft ground or dirt, sod has a tendency to roll up into chunks, damaging the underside of the aircraft's structure. The RU-21D wing-mounted dipole antennas have aluminum hardware with shear capabilties in the event of ground contact. When making a gear-up landing, proceed as follows:

1. Crew/passenger emergency briefing – Complete.

2. Loose equipment – Stow.

3. Seat belts and harnesses – Secure.

4. Gear emergency clutch disengage lever – Disengage.

5. Gear emergency extension handle – Stow.

6. Gear control breaker – In.

7. Gear handle – UP.

8. Flaps – As required.

9. Non-essential electrical equipment – OFF.

10. Condition levers – FUEL CUTOFF (on ground, when able).

11. Master switch – Down.

d. Landing With Main Gear Down, Nose Gear Up or Unlocked. If a landing gear indicator shows an unsafe indication, every possible means should be used to determine the position of the landing gear. If a landing is to be made with the nose gear up or unlocked and the main gear down, then it is recommended that the landing be made on a prepared runway. After touchdown, hold the nose off as long as possible allowing the nose to smoothly touch down with minimum speed. A full flap landing is recommended. After touchdown, flaps should be retracted. Adjusting to full nose down elevator trim at this point will aerodynamically increase up elevator control effectiveness, thus allowing a much lower nose touchdown speed.

Use the following procedure as applicable:

1. Crew/passenger emergency briefing – Complete.

2. Loose equipment – Stow.

3. Seat belts and harnesses – Secured.

4. Non-essential electrical equipment – OFF.

5. Condition levers – FUEL CUTOFF (on ground, when able).

6. Master switch – Down.

e. Landing With One Main Gear Up or Unlocked. If one main landing gear fails to extend and the opposite gear extends normally, a break in the drive mechanism to the unextended gear has occured. If all efforts to retract the extended gear fail, land the aircraft on a runway or on firm, hard surface in preference to loose dirt or grass. On RU-21A aircraft, touchdown smoothly well over to the same side of the runway as the extended gear to allow room for loss of directional control. Holding the opposite wing high and nose straight, lightly apply brake to the unsafe gear. This jar may result in locking the unsafe gear. If not, allow the opposite wing to lower slowly. Evacuate the aircraft as soon as possible. On RU-21D aircraft, touchdown on the same edge of the runway as the extended gear to allow room for loss of directional control. Holding the opposite wing high and nose straight, lightly apply brake to the unsafe gear. This jar may result in locking the unsafe gear. If not, allow the opposite wing to lower slowly on the outboard dipole antenna. If the mission antennas do not shear, apply maximum braking to the extended gear, full opposite rudder and reverse thrust to the opposite engine. If the antenna shears, shut engines down, maintain directional control unit aircraft comes to a stop. Evacuate the aircraft immediately.

1. Crew/passenger emergency briefing – Complete.

2. Loose equipment – Stow.

3. Seat belts and harnesses – Secured.

4. Non-essential electrical equipment – OFF.

5. Condition levers – FUEL CUTOFF (aircraft on ground when able).

6. Master switch – Down.

f. Landing With Nose Gear Down, Main Gear Up or Unlocked. Complete the same approach and procedures as used for GEAR-UP LANDING.

CAUTION

On RU-21D aircraft, maximum bank angle for landing is 4 degrees.

g. Landing With Flat Tire. When landing is made with a flat tire on one main gear, the aircraft may turn toward the flat tire side. Directional control can be maintained with wheel braking and reverse thrust. If aware that a main gear tire is flat, a landing close to the edge of the runway opposite the flat tire will help avoid veering off the runway. If the nose wheel tire is flat, nose wheel stability will be reduced and application of brakes should be used only as required to maintain positive control. Use the following procedures:

1. Land on side of runway favoring good tire.

2. Brake – On good wheel only.

3. Flat nose tire – Use light braking.

CAUTION

On RU-21D aircraft, due to mission antenna clearance, landing or taxiing should not be attempted on unprepared surfaces.

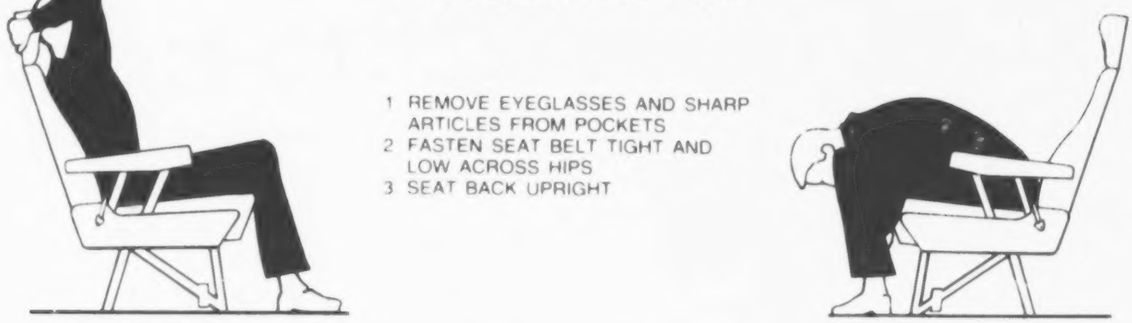
9-14. Ditching.

a. General. The following ditching procedures are based on the experiences of pilots who have successfully ditched other multiengine aircraft. The success of those ditchings were the result of all crewmembers carrying out the correct ditching procedures. Ditching commenced from low altitudes does not always allow time for more than minimum preparation and planning and may not permit relying on a checklist. Therefore it is essential that each crewmember be thoroughly familiar with ditching procedures and assigned responsibilities. Further, the pilot in command must insure that all passengers have been briefed on ditching

BRACE POSITIONS

IN AN EMERGENCY LANDING OR DITCHING SITUATION ASSUME ONE OF THE BRACING POSITIONS SHOWN

1 REMOVE EYEGLASSES AND SHARP ARTICLES FROM POCKETS
2 FASTEN SEAT BELT TIGHT AND LOW ACROSS HIPS
3 SEAT BACK UPRIGHT



REAR FACING

1 RAISE ARMS OVER SHOULDER
2 GRIP THE TOP OF THE HEADREST ELBOWS FIRMLY AGAINST HEAD

FRONT FACING AND COUCH

1 LEAN FORWARD AND AS FAR DOWN AS POSSIBLE
2 CLASP HANDS FIRMLY UNDER LEGS

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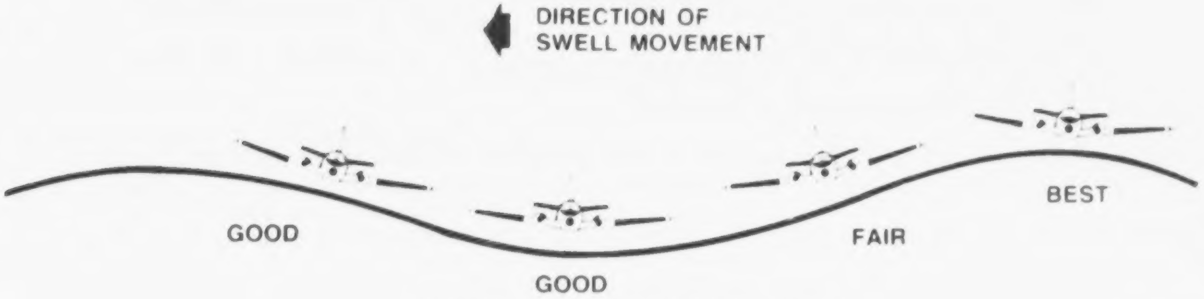
Figure 9-5. Emergency Body Positions

procedures and understand how to use installed survival equipment (fig. 9-5). If at all possible ditching should be made while power is still avilable on both engines. However, if one engine has failed, the ditching should be accomplished in as near symmetrical condition as possible. An engine and/or wing fire is probably the most serious condition from the standpoint of structural integrity and lateral control. A fire concentrated within the wing or nacelle will be sustained by fuel or oil and will destroy effective use of flaps and ailerons in a very short time. With such a fire, except in extremely high wind conditions the aircraft should be ditched parallel to the primary swell system. Model test and actual ditchings of various aircraft indicate that ditchings into the wall of water created by the major swell is roughly analogous to flying into a mountain. Accordingly a careful evaluation of sea condition is essential to successful ditching. While descending, begin analyzing the sea condition as soon as the surface can be seen clearly (2000 feet or more if possible). The primary swell can readily be distinguished from high altitude and will be seen first. At low altitude it may be hidden beneath another system plus a surface chop, but from altitude the largest and most dangerous system will be the first one recognized. The wind driven sea, if any, will be recognized by the appearance of white caps.

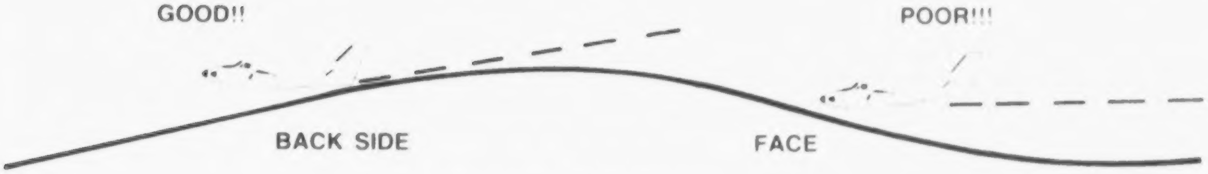
b. Ditching Under IMC Conditions. Where IMC conditions or night operations preclude visual determination of sea conditions, forecast data should be utilized, and the ditching must be made on instruments. With no surface reference, the aircraft must be flown into the water on heading, and in a fixed attitude which combines safe control speed and rate of descent. Whenever possible, ditching should be made as close as safety permits to coastlines or in the vicinity of surface vessels to improve the rescue situation. If radios are still operational, attempt to contact coastal stations or surface vessels for current wind, sea swell, and altimeter setting.

NOTE

Ditch parallel to and near the crest of the swell unless there is a strong crosswind of 20 knots or more. In strong winds ditch heading should be more into the wind and slightly across the swell, planning to touchdown on the upslope of the swell near the top (fig. 9-6). Wave motion is indicative of wind direction, but the swell does not necessarily move with the wind. Water surface conditions are indicative of windspeed, as related below:



LANDING PARALLEL TO THE MAJOR SWELL



LANDING ON THE FACE AND BACK OF SWELL

Figure 9-6. Wind Swell Ditch Heading Evaluation

SURFACE CONDITION	WIND SPEED KNOTS
Few white crests	10-15
Many white crests	15-25
Streaks of foam from crests	25-35
Spray blown from tops of waves	35-45

NOTE

Full flaps are recommended for power-on ditching. However, impaired directional control caused by engine loss or aileron damage is another factor to be considered in determing ditching configuration. At low gross weights, it is possible to retain an optimum ditching airspeed, desired rate of descent, and directional control by using full flaps and power as necessary on the operating engine. If direction control problems are anticipated and available power is insufficient to maintain desired rate of descent, consideration should be given to utilization of APPROACH flaps. It is difficult to judge height above a calm sea, and use of landing lights at night make the estimate even more difficult.

WARNING

Do not remove raft from its carrying case inside the aircraft.

WARNING

Do not unstrap from the seat until all motion stops. The possibility of injury and disorientation requires that evacuation not be attempted until the aircraft comes to a complete stop.

CAUTION

Keep life raft away from any damaged surfaces which night tear it.

c. Ditching Procedure.

(1) Ditching procedure with power:

1. Announce intention to ditch and time to impact.

2. Distress message – Transmit.

3. Transponder – Emergency.

4. Life vest – Put on and adjust (do not inflate).

5. Seat belts/harnesses – Secure (passengers in braced position).

6. Gear – UP.

7. Flaps – Down.

NOTE

Rate of descent, 100 ft. per min. during final stages of the approach (approximately last 300 feet.)

8. Airspeed – 100 KIAS.

(2) Ditching Procedure Without Power:

1. Announce intention to ditch and time to impact.

2. Distress message – Transmit.

3. Transponder – Emergency.

4. Life vest – Put on and adjust (do not inflate).

5. Seat belts/harnesses – Secure (passengers in braced position).

6. Gear – UP.

7. Flaps – APPROACH.

8. Airspeed – 100 KIAS.

d. Water Entry. It is essential that an attempt be made to control the attitude of the aircraft throughout ditching until all motion stops. Evacuate the aircraft through the emergency exit or main entrance door. Take the life raft and first aid kit.

e. After Leaving Aircraft. When safely clear of the aircraft, pull inflation ring to inflate the raft. Tie down first aid kit in the center of the raft to prevent it from being lost in case the raft capsizes. After all personnel have been evacuated move raft out from under any part of the aircraft which might strike them as it sinks. Remain in the vicinity of the aircraft as long as it remains afloat.

9-15. Bailout.

When the decision has been made to abandon the aircraft in flight, the pilot will give the warning signal. Exit from the aircraft will be through the main entrance door, and in the departure sequence using the exit routes as indicated in figure 9-1. Proceed as follows if bailout becomes necessary:

1. Radio – Distress procedure (if time permits).

2. Voice security and transponder – ZEROIZE.

3. Airspeed – Reduce.

4. Flaps – DOWN.

5. Trim – As required.

6. Main entrance door – OPEN.

7. Abandon the aircraft.

APPENDIX A

REFERENCES

Reference information for the subject material contained in this manual can be found in the following publications:

AR 70-50	Designating and Naming Defense Equipment, Rockets, and Guided Missles
AR 95-1	Army Aviation - General Provisions and Flight Regulations
AR 95-16	Weight and Balance - Army Aircraft
AR 380-40	Safeguarding COMSEC Information
AR 385-40	Accident Reporting and Records
AR 700-26	Aircraft Designation System
FAR Part 91	General Operating and Flight Rules
FM 1-5	Instrument Flying and Navigation for Army Aviators
FM 1-30	Meteorology for Army Aviators
TB 55-9150-200-24	Engine and Transmission Oils Fuels and Additives for Army Aircraft.
TB AVN 23-13	Anti-icing, Deicing and Defrosting Procedures for Parked Aircraft
TB MED 501	Noise and Conservation of Hearing
TM 9-1095-206-13&P	Operator's Aviation Unit Maintenance and Aviation Intermediate Maintenance Manual (Including Repair Parts and Special Tools Lists) to Dispenser, General Purpose Aircraft: XM-130
(C) TM 11-5825-252-15	Operator, Organizational, DS, GS, and Deport Maintenance Manual: RU-21D Aircraft Mission Equipment, (V)
TM 11-5841-291-12	Operator and Organizational Maintenance Manual, Radar Warning System, AN/APR-44(V)1
TM 11-5841-283-20	Organizational Maintenance Manual for Detection Set, Radar Signal AN/APR-39(V)1.
(C) TM 11-5841-283-20-1	Organizational Maintenance Manual for Detecting Set, Radar Signal AN/APR-39(V)2.
TM 11-6140-203-14-2	Operator's Organizational, Direct Support, General Support and Depot Maintenance Manual Including Repair Parts and Special Tools List: Aircraft Nickel-Cadmium Batteries
TM 11-6940-214-12	Operator and Organizational Maintenance Manual, Simulator, Radar Signal, SM-756/APR-44(V)
TM 32-1510-209-12/2	Organizational Maintenance Manual, Direction Finder Set AN/ARD-22 (RU-21A)
TM 38-750	Army Maintenance Management System.
TM 55-405-9	Army Aviation Maintenance Manual: Weight and Balance
TM 55-410	Aircraft Maintenance, Servicing and Ground Handling Under Extreme Environmental Conditions
TM 55-1500-314-25	Handling, Storage, and Disposal of Army Aircraft Components Containing Radioactive Materials
TM 55-1500-204-25/1	General Aircraft Maintenance Manual
TM 55-1510-200-PM	Phased Maintenance Checklist
TM 55-1510-209-23	Aviation Unit and Aviation Intermediate Maintenance Manual: Army Models U-21A, RU-21A and RU-21D Aircraft
TM 750-244-1-5	Procedures for the Destruction of Aircraft and Associated Equipment to Prevent Enemy Use

APPENDIX B

ABBREVIATIONS AND TERMS

For the purpose of this manual, the following abbreviations and terms apply. See appropriate technical manuals for additional terms and abbreviations.

B-1. Airspeed Terminology.

CAS	Calibrated airspeed is indicated airspeed corrected for position and instrument error.
FT/MIN	Feet per minute.
GS	Ground speed, though not an airspeed, is directly calculable from true airspeed if the true wind speed and direction are known.
IAS	Indicated airspeed is the speed as shown on the airspeed indicator and assumes no error.
KT	Knots.
TAS	True airspeed is calibrated airspeed corrected for temperature, pressure, and compressability effects.
V_a	Maneuvering speed is the maximum speed at which application of full available aerodynamic control will not overstress the aircraft.
V_f	Design flap speed is the highest speed permissible at which wing flaps may be actuated.
V_{fe}	Maximum flap extended speed is the highest speed permissible with wing flaps in a prescribed extended position.
V_{le}	Maximum landing gear extended speed is the maximum speed at which an aircraft can be safely flown with the landing gear extended.
V_{lo}	Maximum landing gear operating speed is the maximum speed at which the landing gear can be safely extended or retracted.
V_{lof}	Lift off speed (takeoff airspeed).
V_{mca}	The minimum flight speed at which the aircraft is directionally controllable as determined in accordance with Federal Aviation Regulations. Aircraft certification conditions include one engine becoming inoperative and windmilling; a 5° bank towards the operative engine; takeoff power on operative engine; landing gear up; flaps up; and most rearward CG. This speed has been demonstrated to provide satisfactory control above power off stall speed (which varies with weight, configuration, and flight attitude).
V_{mo}	Maximum operating limit speed.
V_{ne}	Never exceed speed.
V_r	Rotation speed.

V_s	Power off stalling speed or the minimum steady flight speed at which the aircraft is controllable.
V_{so}	Stalling speed or the minimum steady flight speed in the landing configuration.
V_{sse}	The safe one-engine inoperative speed selected to provide a reasonable margin against the occurrence of an unintentional stall when making intentional engine cuts.
V_x	Best angle of climb speed.
V_{xse}	Best single-engine angle of climb speed.
V_y	Best rate of climb speed.
V_{yse}	The best single engine rate of climb speed.

B-2. Meteorological Terminology.

Altimeter Setting	Barometric pressure corrected to sea level.
°C	Degrees Celsius.
°F	Degrees Fahrenheit.
FAT	Free air temperature is the free air static temperature, obtained either from ground meteorological sources or from inflight temperature indications adjusted for compressibility effects.
Indicated Pressure Altitude	The number actually read from an altimeter when, the barometric scale (Kollsman window) has been set to 29.92 inches of mercury (1013 millibars).
ISA	International Standard Atmosphere in which: a. The air is a dry perfect gas; b. The temperature at sea level is 59 degrees Fahrenheit, 15 degrees Celsius; c. The pressure at sea level is 29.92 inches Hg; d. The temperature gradient from sea level to the altitude at which the temperature is -69.7 degrees Fahrenheit is -0.003566 Fahrenheit per foot and zero above that altitude.
Pressure Altitude (press alt)	Indicated pressure altitude corrected for altimeter error.
SL	Sea level.
Wind	The wind velocities recorded as variables on the charts of this manual are to be understood as the headwind or tailwind components of the actual winds at 50 feet above runway surface (tower winds).

B-3. Power Terminology.

Beta Range	The region of the power lever control which is aft of the idle stop and forward of reversing range where blade pitch angle can be changed without a change of gas generator RPM.
Cruise Climb	Is the maximum power approved for normal climb. This power is torque or temperature (ITT) limited.
High Idle	Obtained by placing the condition lever in the HIGH IDLE position.
HP	Horsepower.
Low Idle	Obtained by placing the condition lever in the LO IDLE position.
Maximum Cruise Power	Is the highest power rating for cruise and is not time limited.
Maximum Power	The maximum power available from an engine for use during an emergency operation.
Normal Rated Climb Power	The maximum power available from an engine for continuous normal climb operations.
Normal Rated Power	The maximum power available from an engine for continuous operation in cruise (with lower ITT limit than normal rated climb power).
Reverse Thrust	Obtained by lifting the power levers and moving them aft of the beta range.
RPM	Revolutions Per Minute.
Takeoff Power	The maximum power available from an engine for takeoff, limited to periods of five minutes duration.

B-4. Control and Instrument Terminology.

Condition Lever (Fuel Shut-off Lever)	The fuel shut-off lever actuates a valve in the fuel control unit which controls the flow of fuel at the fuel control outlet and regulates the idle range from LO to HIGH.
Interstage Turbine Temperature (ITT)	Eight probes wired in parallel indicate the temperature between the compressor and power turbines.
N1 Tachometer (Gas Generator RPM)	The tachometer registers the RPM of the gas generator with 100% representing a gas generator speed of 37,500 RPM.
Power Lever (Gas Generator N_1 RPM)	This lever serves to modulate engine power from full reverse thrust to takeoff. The position for idle represents the lowest recommended level of power for flight operation.
Propeller Control Lever (N_2 RPM)	This lever requests the control to maintain RPM at a selected value and, in the maximum decrease RPM position, feathers the propeller.
Propeller Governor	This Governor will maintain the selected propeller speed requested by the propeller control lever.

Torquemeter	The torquemeter system determines the shaft output torque. Torque values are obtained by tapping into two outlets on the reduction gear case and recording the differential pressure from the outlets.

B-5. Graph and Tabular Terminology.

AGL	Above ground level.
Best Angle of Climb	The best angle-of-climb speed is the airspeed which delivers the greatest gain of altitude in the shortest possible horizontal distance with gear and flaps up.
Best Rate of Climb	The best rate-of-climb speed is the airspeed which delivers the greatest gain of altitude in the shortest possible time with gear and flaps up.
Clean Configuration	Gear and flaps up regardless of mission antenna installation.
Demonstrated Crosswind	The maximum 90° crosswind component for which adequate control of the aircraft during takeoff and landing was actually demonstrated during certification tests.
Gradient	The ratio of the change in height to the horizontal distance, usually expressed in percent.
Landing Weight	The weight of the aircraft at landing touchdown.
Maximum Zero Fuel Weight	Any weight above the value given must be loaded as fuel.
MEA	Minimum Enroute Altitude.
Obstacle Clearance Climb Speed	Obstacle clearance climb speed is a speed near Vx and Vy, 1.1 times power off stall speed, or 1.2 times minimum single-engine stall speed, whichever is higher.
Ramp Weight	The gross weight of the aircraft before engine start. Included is the takeoff weight plus a fuel allowance for start, taxi, run-up and take-off ground roll to lift-off.
Route Segment	A part of a route. Each end of that part is identified by: a. A geographic location; or b. A point at which a definite radio fix can be established.
Service Ceiling	The altitude at which the maximum rate of climb of 100 feet per minute can be attained for existing aircraft weight.
Takeoff Weight	The weight of the aircraft at lift-off from the runway.

B-6. Weight and Balance Terminology.

Arm	The distance from the center of gravity of an object to a line about which moments are to be computed.
Approved Loading Envelope	Those combinations of aircraft weight and center of gravity which define the limits beyond which loading is not approved.
Basic Empty Weight	The aircraft weight with unusable fuel, full oil, and full operating fluids.

Center-of-Gravity	A point at which the weight of an object may be considered concentrated for weight and balance purposes.
CG Limits	CG limits are the extremes of movement which the CG can have without making the aircraft unsafe to fly. The CG of the loaded aircraft must be within these limits at takeoff, in the air, and on landing.
Datum	A vertical plane perpendicular to the aircraft longitudinal axis from which fore and aft (usually aft) measurements are made for weight and balance purposes.
Engine Oil	That portion of the engine oil which can be drained from the engine.
Empty Weight	The aircraft weight with fixed ballast, unusable fuel, engine oil, engine coolant, hydraulic fluid, and in other respects as required by applicable regulatory standards.
Landing Weight	The weight of the aircraft at landing touchdown.
Maximum Weight	The largest weight allowed by design, structural, performance or other limitations.
Moment	A measure of the rotational tendency of a weight, about a specified line, mathematically equal to the product of the weight and the arm.
Standard	Weights corresponding to the aircraft as offered with seating and interior, avionics, accessories, fixed ballast and other equipment specified by the manufacturer as composing a standard aircraft.
Station	The longitudinal distance from some point to the zero datum or zero fuselage station.
Takeoff Weight	The weight of the aircraft at liftoff.
Unusable Fuel	The fuel remaining after consumption of usable fuel.
Usable Fuel	That portion of the total fuel which is available for consumption as determined in accordance with applicable regulatory standards.
Useful Load	The difference between the aircraft ramp weight and basic empty weight.

B-7. Miscellaneous Abbreviations.

Deg	Degrees
DN	Down
FT	Foot or feet
FT-LB	Foot-pounds
GAL	Gallons
HR	Hours
kHz	Kilohertz
LB	Pounds

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MAX	Maximum
MHz	Megahertz
MIN	Minimum
NAUT	Nautical
NM	Nautical miles
PSI	Pounds per square inch
R/C	Rate of climb

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By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Major General, United States Army
The Adjutant General

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BE EXACT PIN-POINT WHERE IT IS				IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO	
6	2-1 a			In line 6 of paragraph 2-1a the manual states the engine has 6 Cylinders. The engine on my set only has 4 Cylinders. Change the manual to show 4 Cylinders.
81		4-3		Callout 16 on figure 4-3 is pointing at a bolt. In key to figure 4-3, item 16 is called a shim - Please correct one or the Other.
125	line 20			I ordered a gasket, item 19 on figure B-16 by NSN 2910-00-762-3001. I got a gasket but it doesn't fit. Supply says I got What I ordered, so the NSN is Wrong. Please give me a good NSN

SAMPLE

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER
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SIGN HERE John Doe
JOHN DOE

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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